

# Aviation Week & Space Technology

75 Cents

A McGraw-Hill Publication

Mid-December, 1962

**NASA Foresees  
\$5.5-\$7 Billion  
Annual Budgets**

**Grumman GRV-1  
Re-entry Vehicle**



## BUYERS GUIDE ISSUE

Six months of engineering research and development during 1962 have set into motion at Voi-Shan a master plan for one of the largest stocks of all types of Quick Release Pins the aerospace industry has ever known. As the year progresses this stock and product variety will rise to new

predictable heights due to Voi-Shan's skillfully planned system of manufacture to meet the aerospace buyers' needs. ■ Less soon, but interesting, are these Voi-Shan expert guesses for major sports through 1963. Compare your scoreboard throughout the seasons, with those shown here.

## THE ROSE BOWL

January '63: We call it Southern California over Wisconsin.

Your prediction  
And a larger stock of Quick Release Pins to order from Voi-Shan.

## NFL CHAMPIONSHIP

January '63: Predictions, the Green Bay Packers will easily defeat the New York Giants.

Your choice  
And still more Voi-Shan Quick Release Pins ready to order in a range of sizes.

# VOI-SHAN'S QUICK RELEASE PIN BUYERS SCOREBOARD



## NBA CHAMPIONSHIP

Spring '63: Looks good for the Los Angeles Lakers to defeat the Boston Celtics.

Your selection

And the variety and stock of Quick Release Pins goes up at Voi-Shan.



## ANNUAL ALL STAR GAME



July '63: Will see the National League edging out the American League due to superior pricing.

Your opinion  
And leadership in Quick Release Pins grows at Voi-Shan.



## WORLD SERIES

October '63: Shows big crowds to watch the Minnesota Twins defeat the St. Louis Cardinals.

Your prediction

And the finest and largest complete Quick Release Pin stocks are found at Voi-Shan.

How will these selections rate? And yours? Let us know through the year when you select Quick Release Pins—a sure thing—from the all-time greatest selection stock at Voi-Shan Manufacturing Company. Information on this and other precision aerospace fasteners by Voi-Shan is readily available to be sent at your request.

VOI-SHAN MANUFACTURING COMPANY • DIVISION OF VOI CORPORATION • 8463 Heuser St., Culver City, Calif.  
CIRCLE 3 ON READER SERVICE CARD

VSI



1. Ballistic controlled fluid exchanger



2. AD-1000000 valve of control



3. F100 turbo-propeller engine



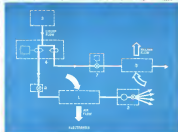
4. Hydraulic shock absorber pump assembly



5. Shock absorber technology



6. Shock absorber technology



7. AD-1000000 valve



8. AD-1000000 valve

## PARTS OR PACKAGES

UAP offers unique skills to design, develop and manufacture any component or complex, sophisticated fluid control systems for space vehicles, missiles, aircraft and ground support equipment. Virtually all components for fluid motion and control—gauges, heat exchangers, packaged electronic controls, valves, actuators, reservoirs, pressure vessels and seals are manufactured by UAP.

Complete fluid systems, designed with matched components all made by UAP, provide ultimate component compatibility, maximum system reli-

ability, space and weight savings, simplified check-out, and single supplier responsibility. For more details, write, or phone 224-3541 today. UAP means United Aircraft Products. Since 1929, a dynamic, independent company in Dayton, Ohio. A name to remember when it comes to fluid motion and control. Outstanding opportunities for qualified engineers.



Circle Number 2 on Reader-Service Card



**you get an "extra" at B&P**

At B & P that "extra" is found in our capability and experience in the design, fabrication and assembly of lightweight and space age metal products. May we have the opportunity to work with you?

An example of our capability is shown here in the manufacture of lightweight close tolerance satellites and instrument cases. B & P has made satellites for several space projects.



Write today for your copy of the new 32 page illustrated booklet entitled "Capabilities".



**b.p. BROOKS & PERKINS, INC.**

2000 W. Park Avenue • Dayton, OH, 45424

## SPECIALIST

### IN HIGH SPEED TESTING

S-N can recommend a high speed actuator with torque greater than 100 inch-pounds. Torque times 7,200 RPM for 30,000 FT/LB S-N will also design and build to your specifications. Info within on specific units and applications available.



**SN** SPEED INCREASER UNITS

SNOW-MASTEDT GEAR CORP.

101 WILSON ST. HAMDEN, CT 06430

Circle Number 24 on Reader Service Card

### AVIATION WEEK and Space Technology

Mid-December 1962  
Vol. 37, No. 37

THIS issue is a special issue, an addition to the regular issue of the December 1962 issue. It contains a special section on "Space Technology" and a special section on "Aviation Week". The "Space Technology" section contains articles on the development of the Saturn V rocket, the Apollo program, and the development of the Space Shuttle. The "Aviation Week" section contains articles on the development of the F-4 Phantom II, the F-105, and the F-106.

The "Space Technology" section is edited by Dr. W. H. Rouse and the "Aviation Week" section is edited by Dr. J. H. Rouse. The "Space Technology" section is published by the American Institute of Aeronautics and Astronautics (AIAA) and the "Aviation Week" section is published by the American Institute of Aeronautics and Astronautics (AIAA).

For further information on this special issue, please write to: Dr. W. H. Rouse, AIAA, 1801 Alexander Bell Dr., Reston, VA 20191. For further information on this special issue, please write to: Dr. J. H. Rouse, AIAA, 1801 Alexander Bell Dr., Reston, VA 20191.

## LUNDY versatility IN ACTUATORS

Lundy specializes in tough activation problems—open or closed loop control—electro-mechanical, hydraulic and pneumatic.

Lundy also has many standardized modular actuator designs for many applications.

Send your actuator and activation system requirements to Lundy for all types of vehicles and equipment: amphibious, land, sea, hydrofoil craft, propulsion, ordnance and others.



**AIRCRAFT:** Lockheed C-130 elevator actuator system provides control through primary air motor drive with no emergency drive backup. Screwjack actuators take up loads and play to 200° even after 100,000 cycles.



**HELICOPTER:** Verter H-30 H-130 unique flight-control actuator means longitudinal cyclic pitch control is not liable to provide speed from 1,000 to 2,000 rpm and non-phenomenal mechanical stops.



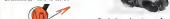
**VTOL:** Lockheed Hummingbird's actuator provides both trim activation and artificial feel in a smaller, single purpose unit and has electro-solenoid free floating feature.



**SATELLITE:** "Sun Shade" hermetically sealed actuator for German GAO provides for rotating mirror for 20,000 cycles in a 30° vacuum space environment. Unit includes vacuum oven optical and instrumentation equipment.



**MISSILE:** Lundy's actuator drives 100,000 mixing valves control the dynamics of air streamers on the Retrom H-1. Unit operates in temperature environment of -60°F to 60°F.



For further information on Lundy versatility write to Catalog L-1.

**LUNDY ELECTRONICS & SYSTEMS, INC.**  
Olean, New York







## Now Multiple PPI Displays Under High Ambient Light Conditions... With GEC Scan Converter

With GEC's transistorized 6021 Scan Converter, it is no longer necessary to look at rapidly decaying PPI displays in dark surroundings. Any number of inexpensive TV monitors can be operated from one PPI source with controlled image storage time allowing more reliable evaluation of displayed information.

Readily tailored to your specific requirements through its plug-in functional modules, the 6021 Scan Converter is capable of:

◆◆◆TRANSLATION of video information from one scanning mode to any other

◆◆◆STORAGE and INTEGRATION of video information

◆◆◆TIME-COORDINATE TRANSFORMATION for expansion or reduction of bandwidth

Contact GEC for more information about conversion of radar PPI to TV, TV standard conversion or conversion of slow scan narrow band TV to standard TV or vice versa.

For integrated systems displaying either optical, sensor or processing electronics, or any combination in most prior requirements, contact

• • • advanced electronics at work



**GENERAL ELECTRODYNAMICS CORPORATION**

4400 FOREST LANE • GARLAND, TEXAS • BROADWAY 8-1111

Circle Number 18 on Reader Service Card

# TECHNOLOGY

## AND RESEARCH HAS MADE KINNEY THE WORLD'S LARGEST MANUFACTURER OF HIGH VACUUM EQUIPMENT

◆ The technical skill of Kinney Vacuum, developed throughout the years, the technology displayed in the advancement of the vacuum pump, high vacuum pumping systems, and the many refinements in high vacuum techniques, all these matured capabilities are employed in the manufacture of such Kinney Vacuum products. Continuous research and development procedures for reliability control guarantee the entire Kinney line of mechanical pumps, diffusion pumps, valves, bellows, gauges, vacuum furnaces, space chambers and clean yield manufacturing plants to be the most modern, intelligent, efficient in operation, and constructed to give the maximum in service.



TRIPLEX HIGH VACUUM PUMP KY 501

Compact design reduces floor space to minimum. New and original balancing technique makes the pump vibrationless. Thrustless displacement of 150 cfm at 25 rpm. Absolute pressure of 10 microns. Compressor is located 50 ft away, saving ample oil supply. Inertness, pumping, general balance, clean, Kinney's oil separator separates oil from gases for direct exhaust. Gas ballast feature prevents considerable vapors from contaminating the oil. Maximum efficiency with a minimum of size and maintenance through optimal design and precise performance. A proven pumping technique, transported in a new configuration.



DYNAMIC DEVELOPMENT  
EXTENSIVE RESOURCES • PROVEN STABILITY



**KINNEY VACUUM**

DIVISION THE NEW YORK AIR BRAKE COMPANY  
2539 WASHINGTON STREET • BOSTON 30, MASS.

Circle Number 11 on Reader Service Card



# Simplified Power for V/STOL Aircraft

Bristol Siddeley lift/thrust turbines are the optimum power units for all V/STOL applications, because the total thrust can be used for both lift and forward propulsion. They permit the simplicity of a single-engine installation on, and with, separate lift engines, they provide a simple and easy maintenance solution that can be achieved with any combination of separate lift and propulsion engines.

## SINGLE-ENGINE INSTALLATION

- Simplified installation.
- Simplified aircraft control.
- The auxiliary thrust will include drag

power through a fixed point near the aircraft centre of gravity.

- Maintenance and repair requirements are reduced to one engine.
- Availability of a large power reserve for acceleration and manoeuvres.

## MULTI-ENGINE INSTALLATION

- Power equivalent lift engine required as the total propulsion power is also available for take-off.

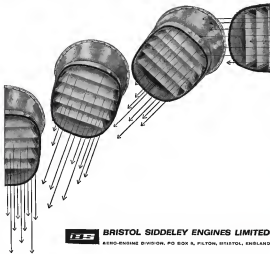
## SUPERSONIC FLIGHT

In Bristol Siddeley lift/thrust turbines fuel can be burned in the by-pass starting or preburner chamber to give a thrust boost for

take-off and supersonic flight. This gives a further thrust reserve —

- A large thrust boost for maximum speeds with only a modest increase in specific fuel consumption.
- Simple performance matched to aircraft engine requirements.
- Greater thrust for maximum acceleration.
- Greater radius of operation.

These thrust boost advantages are achieved more economically by providing thrust for braking than by relying on the hot exhaust gases. The development of Bristol Siddeley lift/thrust engines is supported by the US Government through the Naval Weapons Development Program.



**BRISTOL SIDDELEY ENGINES LIMITED**

AERO-ENGINE DIVISION, PO BOX 8, FULTON, BRISTOL, ENGLAND

**Flexonics products, services, and facilities for the aerospace industries...**

## PRODUCT APPLICATION ENGINEERING



Wherever you find a broader application in the design and development of flexible and light-weight turbine components for aircraft and missiles (such as Turbines, Flexonics engineers — both in the field and in the plant — draw on a line of experience that includes participation in most of the United States' major aircraft and missile programs. The experience is most in solving your design problems.

## METAL HOSE AND CONNECTORS

Flexonics offers the broadest line of flexible metal hose and connectors to meet your exacting requirements in extreme applications for aircraft applications — to solve the problems caused by vibration, misalignment, thermal expansion, and pressure. Our metal hose, in various sizes, is available in 1/2" through 12" I.D., easily adapted for use with high velocity, flexible, or coupling, or with special temperature.



## FLEXIBLE JOINTS AND DUCT ASSEMBLIES



Both free-flaring and self-restrained flexible joints for ensuring system flexibility under conditions of vibration or thermal change. Found in many critical applications such as propulsion lines, vent and permeation ducts, relief air pressure systems, and gas turbine engines. Components of complete ducting systems, including high strength, thin-wall stainless steels in tubing.

## CRYOGENIC CLEANING FACILITIES



Flexonics facilities for cryogenic cleaning applications include use of the most advanced and outstanding cleaning facilities. The cryogenic technique developed for propellant cleaning at Flexonics is also available for other products on a contract basis. Why not request a quote using the approved and certified facility for your own products?

Here are the facilities for research, engineering, manufacturing, testing, and evaluation, and facilities for testing the most complex and high-pressure systems on aircraft and missile engine systems. Only at Flexonics will you find this fully integrated service. To make your own design job easier, submit it to Flexonics in only a few weeks in the development stage.

Mail the coupon today! Check your field of interest and clip the coupon to your letterhead.

**Flexonics**

DIVISION OF CALUMET & HECLA, INC.  
235 East River Avenue • Bensenville, Illinois

Flexonics is a member of the Calumet & Hecla Corporation, a subsidiary of the Calumet & Hecla Corporation.



In Canada, contact Flexonics Canada Ltd., 1000 St. John St., Montreal, Quebec H3B 2G1.

Flexonics  
235 East River Avenue  
Bensenville, Illinois  
Please send me literature on the subject of:  
☐ Flexible and  
Connectors  
☐ Flexible joints and  
Duct Assemblies  
☐ Frequent  
Cleaning  
☐ Cryogenic  
Cleaning  
☐ Testing

# SPACE COMMUNICATIONS

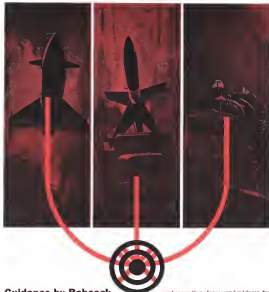
## MILLIONS OF CONVERSATIONS...

*on a beam of light*

A pencil of ruby light will slash across the vast continuum of space carrying millions of conversations on its solitary beam. Philco Research Scientists are busy today developing lasers for the next generation of communications systems . . . learning how to use the virtually unlimited information-carrying capacity of this unique device . . . preparing to provide effective communications for space probes and manned vehicles coasting among the galaxies. Ruby lasers are typical of Philco's increasing efforts to increase its leadership in all areas of communications for defense and industry.

**PHILCO** *Answers for Quality  
the World Over*  
a subsidiary of General Electric Company

Communications and Electronics Division • Computer Division • Lardale Division  
• Scientific Laboratory • Space Electronic Division • Technical Division • Western Development Laboratories



## Guidance by Babcock

For 35 years Babcock has been a major supplier of command guidance and control systems for the armed forces. Over 100,000 such systems, if constantly improving sophistication and capability, have guided unmanned aircraft such as the Army/Air Force GO-55, the Navy KDD-2, KDD-6, KDD-3, XDD-8 and others. Custom-designed Babcock systems control unmanned Signal Corps surveillance aircraft. LaGrone, DASH, and AEG's remote-controlled locomotives for nuclear experiments use dependable Babcock equipment. Now Babcock is developing the

next generation of command guidance, for orbital rendezvous and space vehicle control. At all levels of technical sophistication, Babcock emphasizes light weight, compactness, reliability and economy. For long or short range, analog or digital command, Babcock has the know-how to solve your guidance problem. Contact Marketing Manager, Melling Station 788.



**MILITARY  
PRODUCTS  
DIVISION** **BABCOCK**

**BABCOCK ELECTRONICS CORP.**  
1822 WILSON AVENUE • COSTA MESA, CALIFORNIA

# COUNTDOWN ON RELIABILITY

Reliability typifies the Stearns-Roger staff of specialists in the fields of missile, cryogenic and nuclear facilities. Reliability requires the dedicated services of experienced and competent engineering personnel in the areas of criteria development, design, procurement, installation, check-out and operation.

Rely upon Stearns-Roger capability gained over the years in the Atlas, Titan, Minuteman, Saturn and associated programs.

With proven management and dependable, integrated engineering and construction staffs, Stearns-Roger can function under any contract to provide single responsibility for your requirements.

- 6 Management
- 5 Engineering
- 4 Procurement
- 3 Installation and Checkout
- 2 Systems Manuals
- 1 Operation and Maintenance



*a comprehensive guide to current  
information on every branch of  
Science and Technology*

*... a practical new way to bridge the gap between your  
specialty and other fields into which your work leads you*



New from  
**McGraw-Hill**  


**If you find yourself among the  
growing number of science and  
engineering specialists unable  
to keep up with the explosive  
pace of developments today, you  
will see a valuable solution at  
the top of this page.**





**GOODBYE  
COMPRESSED AIR!**

### ...Aerotec Low Pressure Gas Generator Inflates Flotation Systems



**Remotely Operated**



**Propulsion**



**Valves**



**Flotation Systems**



**Composites**



**Hydrogen Inflation**

Introduction of the unique Aerotec Flatfree System replacing a low pressure gas generator has obviated the heavy air compressor or tank required for inflation. These systems are part of the Navy DASRI (Dive Air-Supply) Helicopter program. Savings in weight are thus available for additional payload capacity in the drone.

If you require a simple pressure switch or complex system, Aerotec offers you the advantage of a vast experience gained in the development of hundreds of thousands of valves, float switches, disconnects and a variety of components and systems. They are specialists in precision equipment for the aircraft, missile and nuclear industries.

This imaginative approach to new developments can be used by your company to reduce assembly time in many areas, from aircraft to engine and nuclear components and systems. Write or phone Aircraft Equipment Division, Aerotec Industries, Inc., Oronoch, Conn. In Canada: T. C. Chown Limited, Montreal & Toronto.



Other divisions:

**AEROTEC DIVISION** Aircraft Engines, Propellers and Gas Turbine  
**INDUSTRIAL DIVISION** Heat Treating Equipment, Hot Gas Engines, Fans, Blenders and other equipment.

Circle Number 20 on Reader Service Card

### A MAJOR ADVANCEMENT IN HIGH TEMPERATURE MATERIALS COATED PARTICLES & PARTS BY NUMEC

UNUSUALLY RESISTANT TO HIGH TEMPERATURE  
CORROSION OF METALS AND NON-METALS coatings  
on base materials.

#### TYPICAL COATINGS

Co + Ni + Cr + Mo + V + Mn + Si + Fe +  
W + Zirconium + NiO + SiO<sub>2</sub> + Al<sub>2</sub>O<sub>3</sub>  
(Other coatings also available)

#### TYPICAL BASE MATERIALS

UO<sub>2</sub> + UC + U<sub>3</sub>Si<sub>2</sub> + ThO<sub>2</sub> + WC +  
SiC + SiN<sub>4</sub> + C + Glass + AlN +  
Alloys + metal powders + ceramics +  
refractory metals + graphite

NUMEC coatings can be applied to base materials by  
using hot pressing, sputter, cathode, dipping, plasma,  
electro, and other more complex techniques. The in-  
formation on coated particles, nuclear applications and  
other services is available.

## NUMEC

Nuclear Materials & Equipment Corporation

Aparto, Pa. Phone: (610) 271-2111

Circle NUMEC TBS AFD-276

NUMEC's growth is constantly meeting new and old  
market requirements for materials and equipment in  
nuclear research and development. Write today for more  
information.

Circle Number 20 on Reader Service Card

### THE WORLD'S SKINNIEST ENCYCLOPEDIA... FREE.

Volume length: 7 pages.  
Reading time: 11 min. and 22 sec.  
Concise coverage in this edition and  
bits of knowledge and information  
that can prove invaluable to you  
without strain, you may quickly identify  
the many Aerospace services now  
being provided by Adel. Appropriate  
to the aerospace demands of our  
industry, Adel's service knows no limits  
beyond. With no commitment on  
your part, you are invited to write for  
this free booklet detailing Adel's  
products, facilities and capabilities.

WRITE  
**ADEL**  
DIVISION  
GENERAL METALS CORPORATION  
30777 Norwood St., Norwalk, Conn. 06851  
16 P-101-1. Sent without comment attached.



Circle Number 25 on Reader Service Card

23

## QUALITY CONTROL Starts with Calibration



Model L500  
and  
Model L967



Model R120



Model R025/4



Model R120



Model R120

The advantages gained by calibrating and maintaining electrical measuring instruments using self contained, console type standards are impossible to duplicate using individual components. There ease of operation, long term stability, accuracy, wide current and voltage ranges, and built-in safety provisions yield consistent results in reference to our unique over sight methods of calibration.

Since development of the original self contained instrument calibration standard for the U. S. Navy in 1945, RFL has produced many variations and offers the world's widest selection of such equipment. Choice of direct comparison, regulated potential and AC transfer methods with accessories to meet all commercial and military requirements for working or reference standards is available. None of the models currently in production are illustrated. They can be seen at the factory or by arrangement with local representatives in most areas and 20 overseas countries.

Performance summary accompanied calibration certificates for each current and voltage range, at all units, are supplied. Accuracy is traceable to primary standards at the National Bureau of Standards.



**Radio Frequency  
LABORATORIES, INC.**  
Secton, New Jersey, U.S.A.

SEND FOR  
TECH  
DATA

For additional information, including application literature, write or telephone (609) 426-1000. Complete, confidential, and reliable information by mail upon request.

Circle Number 24 on Reader-Service Card

## THERE'S MORE TO

**AAF's  
MINUTEMAN  
ASSIGNMENT  
THAN  
AIR CONDITIONING  
A HOLE  
IN THE  
GROUND**



Untested, isolated, in these underground sites, the Minuteman must remain operational at all times—ready for instant performance. Helping the Air Force Reliability Program meet this challenge, American Air Filter Division and its supporting air intake environmental control system including temperature and humidity controls, heating, cooling, and independent and air filtration. Guarded with the weapon system the AAF equipment protects itself as well as the Minuteman. Control center personnel are protected by chemical, bacteriological, and radiological air filters.

American Air Filter capability is based on years of leadership, with experience in all types of "hot air" removal. Products include Nite-Ban, Jotex, Therma, Perma-Ban, and the Century Series Filters. Can we help you? Defense Products Division, American Air Filter Co., Inc., 200 Third St., Rock Island, IL, Phone 284-5211.

Send for literature to day



Circle Number 22 on Reader-Service Card

## The only COMPLETE FASTENING SYSTEM for the Aircraft and Missile Industry



**STANDARD CHERRYLOCK** Rivets for solid rivet strength... top performance in a complete range of diameters and grips. Qualified under NAS Specification 1400 and Standards Pages 1204 and 1306 (U. S. Patent No. 2931532)

**BULBED CHERRYLOCK** Rivets for thin sheet and double-chock applications. Short grip... strong joint... extremely large blind head and bearing surface.

**CHERRY "9000"** series serrated stem MS rivets and Cherry Standard MS knob stem rivets for a complete line.

**CHERRY AIRCRAFT LOCKBOLTS** for high strength... high temperature and corrosion resistant service, are available in a full range of diameters, grip lengths and head styles.

## A-286 STAINLESS STEEL \* MONEL \* ALLOY STEEL \* ALUMINUM

The Complete Fastening System  
Cherry Blind Rivets—Cherry Aircraft Lockbolts\*—and  
Cherry Installation Tools

\*Qualified under Nash Plans: R03793, 311443, 3427407, 3310048, 3331041 and 3734703

**Cherry Rivet Division**  
Sparta, Ark., Calif.



## Townsend Company

ESTABLISHED 1934 • SPARTAN, PA. • A CHERRY COMPANY

In Canada: Forman & Sells Manufacturing Company, Limited, Downsview, Ontario

Circle Number 27 on Reader-Service Card

# HAWS

## Safety on tap!

...for on plant protection against injury from contamination by caustics, chemicals, radioactive materials, etc. Plastic emergency fixtures with Microdot "lead proof" equipment.



MODEL 7700 BT  
For eye spray only



MODEL 7700  
For face wash only



**EMERGENCY  
EYE WASH  
FACE WASH**

MODEL 8000  
For the face (shown)



MODEL 8000  
For the face (shown)

**DECONTAMINATION  
DRENCH  
SHOWERS**

Both models are easily and safely installed, allowing a clean, easy, emergency fixture that stays out of the way.

Have microdot make a complete line of emergency eyewash, face wash and drench shower equipment. For full information and specifications details write for Microdot Safety Catalog.

# HAWS

**EMERGENCY EQUIPMENT**

Circle 100

1440 South Street • Lafayette 18, California



### Hermetic Sealing

Complete in-plant capabilities for plan to metal sealing—from design through quantity production—are provided by Microdot's Hermetic Seal facility. Specializing in custom sealing, as well as hermetically sealed containers and terminals, Microdot engineers will work with your engineering department and provide design solutions to your sealing problems. All Microdot hermetic seal services include quality control and inspection, including final test by helium leak detector sensitive to  $5 \times 10^{-11}$  atm. cc/sec.



### Microminiature Multi-Pin Connectors

Industry's most versatile, truly miniaturized connectors. Only  $\frac{1}{16}$  size, 15 weight of current "miniature" types, Microdot Multi-pin contains up to 61 pins or 39 contact contacts in a  $1\frac{1}{2}''$  shell, and also available in shell sizes down to  $\frac{1}{16}''$ . Standard line offers many options: interchangeable inserts for straight power, straight coax or complex custom power-coax layouts, choice of sockets and flanges, quick disconnect or screw-type couplings, assembled with specified Microdot cable or is left for on-site field assembly. Hermetically sealed connectors available on special order.

### MICRODOT INC.

226 Pasadena Avenue  
South Pasadena, California  
General: (818) 797-4100 • Telex: 7544

Circle Number 91 on Reader Service Card

## What industrial plastics do you need?

### Mechanical grades?



Formica has sheets, rods, tubes. High mechanical strength, good punching and mechanical properties. For rocket motor cases, blast tube insulators, gears, pump parts, etc.

### Electrical grades?



Formica has sheets, rods, tubes. Over 18 grades—we have the combination of properties you need. For use in machines, computers, TV, radio, radar.

### Copper clad laminates?



Formica has glass-epoxy, paper-phenolic, nylon-phenolic grades. Clad one or both sides. Flame retardant or non-retardant. Also multi layer circuitry materials and laminates meeting MIL-specs. For modules, computers, etc.

### Molded products?



Formica has thermosetting plastics which can be molded in these shapes: laminated, macerated, or explosion laminated/macerated. Complete molding service available—materials selection, mold design, tooling.

### Engraving stock?



Formica has 13 standard colors and natural grains. Several thicknesses. Core: white, black, or white sub-core and black core. For monogram and signs on aircraft components, instrument panels, etc.



### Formica has the grade you need.

For details use  
this coupon.

AM-10

#### Gentlemen:

Please send me data on the Formica industrial plastics checked below:

- |  |  |
|--|--|
| <input type="checkbox"/> Mechanical Grades                           | <input type="checkbox"/> Electrical Grades |
| <input type="checkbox"/> Copper Clad Laminates                       | <input type="checkbox"/> Molded Products   |
| <input type="checkbox"/> Engraving Stock                             |  |
| <input type="checkbox"/> Please have your representative contact me. |  |



#### Industrial plastics

#### FORMICA CORPORATION

subsidiary of  
45th SPRING GARDEN AVENUE  
CONCORD, N.H. 03301

NAME \_\_\_\_\_  
TITLE \_\_\_\_\_  
COMPANY \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_  
TELEPHONE NO. \_\_\_\_\_ EXTENSION \_\_\_\_\_

**FREE SHOWING!**  
**ALL NEW TRAINING FILM**  
By-Check—The Dye Penetrant Inspection Process

**PIN-POINT  
FLAW LOCATION** WITH  
**DYE-PENETRANT PROCESSES**

**NEW!**  
Full Color  
Training Film  
No. 31

*This Film is ALL NEW...*

The third one produced by the Technical Film Group of Trucon, developer of the By-Check inspection process...providing most often used in manufacturing and maintenance.

**MORE THAN 18,000** Production and Quality Control inspectors and supervisors have now viewed the first two By-Check films. Every man concerned with flaw location and a craftsman not feeling it is hard to see this new Film No. 3 from Trucon. **ANY CROOK** in your plant can leave the new complete step-by-step story of positive flaw location with dye penetrants.

**WITNESS** actual practical flaw location procedures made in your own plant!

**FLAW YOUR FILM SHOWING NOW!**

Write today for the "Pin-Kit" described below. No charge for this material!

**YOUR FREE "FILM KIT"**

will include:

1. Important Publications:

1. Trucon color brochure for By-Check

2. Brochure showing basic steps and the

advantages of and what this kit can do

3. Technical data folder describing a variety

of uses of the penetrant inspection film

4. 16mm film "How To Use This Kit"

**SEND FOR FREE KIT!**

**TURCO PRODUCTS, INC.**

Technical Training Company,  
c/o Bendix Elmira Division, Elmira  
Aircraft Division, Elmira, New York  
Elmira Division, Elmira, New York  
Elmira Division, Elmira, New York

**TURCO PRODUCTS, INC.**  
1000 Elmira Road, Elmira, New York  
Phone and Telex: TURCO 1-2111  
Telex: TURCO 1-2111

**SEND FOR FREE KIT!**  
Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_  
State \_\_\_\_\_  
Zip \_\_\_\_\_

Circle Number 30 on Reader Service Card

## Fiat aviation

over 50 years of activity

*so far*

167 types of aircraft  
and 55 types of aviation  
engines manufactured,  
70 international records  
and medals.

*to-day*

4 modern factories  
3 engineering departments  
3 different aircraft models,  
1 helicopter and 3 types  
of jet engines in production  
4 aircraft models and  
7 different piston and jet  
engines being overhauled.

contribution for the last decade of  
components and parts for 100,000  
jet planes and for 100,000 jet  
helicopters.

participation in the project and  
coordination of the main maintenance  
components for the S.E. 350 B  
Twin Otter helicopter.

**FAT-DIVISIONE AVIAZIONE**  
Cassa E. 4000 200 - Torino (Italy)

Circle Number 37 on Reader Service Card

## fasteners for high temp use

**SHOCK HEAD - HEX HEAD -  
ST POINT HEAD - FLAT HEAD -  
BUTT HEAD - AN-HEAD & M.S.**

**1/8" - 4 1/2" (AMS 5706)  
1,500 Effective Temperature Ranges**

Certified to precision heat  
treatment, Marquy High Temp  
fasteners are available in  
a wide variety of sizes and  
materials including, stainless  
steel, Inconel, Monel, and  
Titanium. Quality Control  
at Marquy is second to  
none. We use the  
most modern Q.C. tools  
and techniques to  
guarantee the  
highest quality.  
AMS 5706  
1,500  
1,500  
1,500



Write for  
Catalog No. 20  
3000 Marquy Rd., Cedar City, Mo.  
Phone 314-241-1111 Telex 688-02-1111

Circle Number 38 on Reader Service Card



**OUR FUEL NOZZLE HAS JUST FINISHED  
EATING 1,000 HOURS WORTH OF DIRT.**

**(With no unpleasant after-effects.)**

There's what the pile is. The amount of dirt that accompanied  
the fuel used to run a engine for 1,000 hours. It's almost what  
you could expect if you were to rub a slender test on your engine  
with the fuel you normally use.

Since dirt is supposed to foul fuel nozzles, you might also ex-  
pect the fuel nozzle would foul. Sure, don't it? Why? We see it.  
We purposely designed our fuel nozzles to perform under  
every condition. Carbonaceous deposits in nozzles. High temp.

performance don't help much. Lesser nozzles really get choked  
up when the heat is on. Not ours. Bendix® fuel nozzles supply  
full atomization over a complete flow range. They don't gum  
up. They don't change calibration.

If you build engines for jets, missiles, helicopters or anything  
else that needs a fuel nozzle for full range work, write us for de-  
tails. The Bendix Corporation, Elmira Division, Elmira,  
New York.

**Bendix-Elmira**



## WHEN PRECISE CONTROL IS AN ABSOLUTE REQUIREMENT



Aeroflex DG Torque Motor  
Precision built for precision torque.

The world's largest manufacturer of stabilized aerial camera mounts has developed a DG Torque Motor of outstanding accuracy and sensitivity—that can be used as a direct drive servo motor, low speed, high accuracy tachometer, instant drive, valve motor, reliable control surface actuator, throttle control, business machine and computer drive.

This torque motor has only two parts—a total motor and a load—no motor stator—there are no brushes, no commutator. It is explosion proof and has virtually unlimited service life. It meets full military environmental qualifications and exhibits no motor ripple, therefore, allows infinite resolution.

The Aeroflex DG Torque Motor is available in circular or segmented configurations in capacities from 0.1 oz. in. to 75 lb. ft. with rotational limits to a 60 degree.

For more information on this unique drive, write Dept. JL-00.

## AEROFLEX LABORATORIES

1000 EASTERN  
4830 20TH STREET • LONG BEACH CITY, N.Y.  
STABILIZED PLATFORMS • SYNC • CIRCUIT ISOLATING SYSTEMS • ANALOG COMPUTERS

Circle Number 29 on Reader Service Card



## NEW from ANCHOR<sup>®</sup> HDP Hose Assemblies for Aircraft, Missile H.P. Pneumatic Servicing

hdp high density polyethylene inner tube

1. Broad and rigid pipe are of stainless steel for maximum corrosion resistance
2. Monopipe design to withstand rough handling and exposure
3. Another benefit of stainless steel, ductile sleeve swaged, couplings are

leak proof and permanent! One-piece hose, 316 stainless steel tube to match with MIL-H-8838A O-ring seals.

The Anchor HDP Hose Assemblies fully conform to MIL-H-8838A (USAF) specifications. Available in the 4, 6, 8, 10 and 12 inch for 4200 PSI WP and in the 4 inch for 4200 PSI R.P. Temperature range 50°F to 300°F for service with any fluid per Department of Army MIL SPEC CATALOG Item 1.

ANCHOR Coupling Co. Inc.

235 North Fourth Street, Detroit, Mich.  
Branch House, Detroit, Mich., Plymouth, Mich.

Circle Number 22 on Reader Service Card



## LISLE Magnetic CHIP DETECTORS

Lisle Magnetic Chip Detectors give you early detection of internal breakdowns, insuring against premature engine or engine failure.

Remove particles in a laboratory as a direct indication of engine wear or impending breakdown. The Magnetic Chip Detector attracts these particles which lodge on electrically insulated pins in the detector, completing a circuit which activates a warning light on the instrument panel.

Chip Detectors are used today in all end use reciprocating engines, auxiliary drives, propellers, constant speed drives and hydraulic systems in commercial and military aircraft.

Write for Catalog and Sample for Testing

LISLE CORPORATION  
Cincinnati, Ohio

Circle Number 29 on Reader Service Card

# WHY DID THEY WAIT 'TIL NOW TO THINK OF A COMPRESSED PACKAGING MATERIAL?

It's not at all new, it's very much the best of this world! A compressed packaging material is that kind of an idea. Actually, it isn't totally new. We'd been packing packing materials for a long while—including a special compressed grade for military and export use—before we perfected K-51, the new, all-purpose Kungpak® compressed inner packaging.

We haven't been sitting on a good idea. We waited until we had enough experience to know the product was ready. It is.

Now compressed Kungpak K-51 is simple and simple here's how it works. K-51 Kungpak is compressed to one-fifth its normal length. Then it's shaped that way to you, offering a big saving in handling and storage space. As your packers use it they merely put it out to its normal length—five times the compressed length.

But that's only part of the story. There's a lower price, exceptional conformity to your products, a special feature that makes your products into something. Learn K-51's many other advantages by writing for a FREE, no-cost sample of new Kungpak compressed today.



Kimberly-Clark

## FREE SAMPLE OF KIMPAK<sup>®</sup>

Now learn the benefits of K-51  
new Kungpak compressed inner packaging  
from a no cost or delayed cost

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_

MNL 70 Kimberly-Clark Corp. Dept. 44-222, Norwalk, Conn.





New from G. E. 16-page 5-Star tube booklet tells...

## How to *value-analyze* airline electronic tubes for highest reliability

If you buy or use electronic tubes, you'll want this handy, 16-page, 5-Star booklet.

- You'll learn why more airlines use G-E 5-Star Reliability tubes than any other type.
- You'll be able to make objective evaluation of your equipment's performance compared to similar equipment using G-E 5-Star tubes.
- You'll have complete technical data on

all fifty 5-Star types conveniently at your finger tips.

- You'll see some of G.E.'s new national developments and the 11 national-level benefits that ensure tube reliability.
- You'll see the factors in high reliability performance and money-back guarantees.
- You'll also learn about G.E.'s new T119 (Technical) Information and Product Approval group and how it can help you solve problems involving the use or selection of G-E tubes.

Request *Our Best Inspection Report*  
**GENERAL ELECTRIC**

For rapid reliability on all G-E high-reliability tubes, see your authorized G-E Industrial Electronic Components Distributor.



Circle Number 54 on Reader Service Card

## AT HIGH OR CRYOGENIC TEMPERATURES



### PREVENT CRITICAL SYSTEMS FAILURE... LIQUID AND GAS ESCAPE

Extreme environmental and operating conditions encountered in the aerospace industry require sealing methods and products that will perform faultlessly. Advanced Metal-O-Rings, designed to stand up under a wide range of temperatures — and pressures — are today employed on hundreds of aerospace liquid and gas systems to ensure positive sealing... prevent systems failure.

#### ADVANCED METAL-O-RINGS

- SEAL FROM -400°F TO 2800°F
- RESIST RADIOACTIVITY AND ELECTRONIC CONDUCTIVITY and the corrosive effects of acids and chemicals.
- IN DIMENSIONS FROM 3/16" to 12"
- WITHSTAND PRESSURE EXTREMES FROM 10<sup>-10</sup> mm Hg. to 10,000 psi
- PLATED IN SILVER, GOLD, NICKEL, COPPER, ETC.
- REPLACEMENT COSTS ARE LOW
- MADE IN ALL SHAPES

SEND US YOUR SEALING PROBLEM AND WRITE FOR FREE 1972 DESIGN MANUAL



99A Broadway  
North Haven, Connecticut

Circle Number 41 on Reader Service Card



APEX Military Universal Joints are built to conform with and exceed all requirements stipulated in Specs. MIL-J-1418A, Class 2, Standard Drawing MS-20711 (Heavy Duty) and Class 1, Standard Drawing MS-20710 (Light Duty), as indicated in Qualified Products List QPL-6183-D. SPECIAL THERMAL STRENGTH, IN ALL-TEMPERATURES, HIGH SPEED, HADSTAND TO HARD STRENGTH, PROVEN.

**APEX**

### Military Universal Joints Offer

#### BALANCED DESIGN

High axial and torsional strengths.  
High strength-to-weight ratio per size.  
Maximum maintenance efficiency.  
No replacement during anticipated service life of airplane on most applications.  
High mechanical efficiency, low wear.  
Low torsional deflection.  
Not adversely affected by lubricating or fast corrosion under shock loads or vibration, or by spreading overload.  
DOWNSIDE SIZE: 3/16" STANDARD 196"

#### PERMANENT LUBRICATION

Working parts enclosed in covers especially adapted for service in heat, cold, ozone, oil, etc.  
SEALS, LUBRICANT-RETAINING COVERS provide a supply of lubricant in excess of actual requirements, for long service periods.  
Resisting dirt, sustain lubricating film in bearings.  
Provide high resistance to vibration, offer vibration dampening.  
Increase heat dissipation; eliminate corrosion.

Write For Catalog 34

## UNIVERSAL JOINTS and ASSEMBLIES

**APEX**  
The Apex Machine & Tool Company  
1025 So. Posterson Blvd.  
Dayton 2, Ohio

Circle Number 37 on Reader Service Card

## The whole is greater than the sum of its parts in CRYOGENIC SYSTEMS built by COSMODYNE

Experience and Cosmodyne's commitment are the two factors that make the whole greater than the sum of its parts. Fast service and pre-engineered product quality. High pressure gas systems, space simulation and test complexes are a few of the systems designed by Cosmodyne.

Let us put our experience to work for you in:

- HYDROGEN
- FLUORINE
- HELIUM
- ARGON
- NITROGEN
- OXYGEN



Send for my nearest  
**THE COSMODYNE CORPORATION**  
 2232 W. EL SEGUNDO BLVD., HAWTHORNE, CALIF.  
 90250-1000 (213) 931-1111  
 Circle Number 40 on Reader Service Card

## MIDWESTERN INSTRUMENTS ANNOUNCES: DELUXE FEATURES ARE STANDARD IN NEW, MODERATELY PRICED MODEL 800 OSCILLOSCOPE



Simplicity of controls, transmission is featured by the new Model 800 oscilloscope. This high quality, direct writing, light beam galvanometer type recorder writes overlapping traces. ■ Standard features include 25 active galvanometer channels on 4" recording paper with a 32" optical magnification area, low cost multiple pin galvanometer input connectors, push button controlled electric shift transmission with 8 paper speeds from 1" per sec. to 320" per sec., 475 foot record capability, and power footage counter. ■ Optional features include provision for up to 36 channels, 4 megabyte flash memory, trace identification by optical identification or sequential trace numbering, remote control unit, and many other extras.

For complete information and specifications, write:

## MIDWESTERN INSTRUMENTS

P.O. BOX 7000 TULSA, OK, OKLAHOMA

Circle Number 38 on Reader Service Card

## SYSTEMS PROGRESS



## INSTRUCTIONS FOR SATELLITES

One of OSC's space support systems, produced for NASA's Goddard Space Flight Center, is the Maintrack Digital Command Console.

Installed at 13 NASA tracking stations around the world, this system is part of the complex of electronic equipment used to track and acquire data from earth-orbiting satellites. The console generates digital and tone commands which are relayed by transmitters to the satellites.

Thirty tone frequencies or 50 digital commands are available, selected manually by switches or programmed automatically from fan-level punched paper tape.

This is one example of OSC's interest in space sciences and support systems. Many other custom engineered systems have been developed in the areas of analog and digital data handling, electro-optical instrumentation, environmental testing and industrial control. For details on how this experience can be useful in solving your systems problems, call our regional engineering office or write.

## CONSOLIDATED

## SYSTEMS

## CORPORATION

3100 So. Siemrock Ave., • Monterey, California  
 Circle Number 42 on Reader Service Card

## SPECIFY STRATOFLEX



SUPER-T TEFCON  
 12V001-S-L  
 MS-H-2537 Hose Assembly



SUPER "TIP" TEFCON  
 12V001-S-L  
 MS-H-604 Hose Assembly



113226-S-L  
 "113" Hose up to 40% lighter  
 than conventional MS-H-604

## FOR EVERY AIRCRAFT AND MISSILE



115-312-312-S-L  
 MS 25790 Hose Assembly  
 MS-H-8752 Hose



115-342-342-S-L  
 MS 25762 Hose Assembly  
 MS-H-8758 Hose



111-312-312-S-L  
 MS 26741, MS 24587 (MS-H-8755)  
 Hose Assembly  
 MS-H-8754 Hose

## FLEXIBLE FLUID LINE REQUIREMENT



173-311-311-S-L  
 AN 6276 Hose Assembly  
 MS-H-8393 Hose



SPECIAL CONFIGURATIONS—shown here  
 are a few of the many different configurations  
 that Stratoflex has supplied to industry.

(Where hose assemblies continue in series, refer to specifications listed.)

STRATOFLEX offers complete hose assemblies, hose and fittings in a wide range of sizes and types, allowing engineers exceptional freedom in equipment design. Stratoflex flexible hose and fittings are available for most fluid applications and for a wide range of pressures. Medium pressure Super-T Teflon® and high pressure Super "TIP" Teflon® are designed for extreme temperature applications.

GET COMPLETE INFORMATION: Write for Stratoflex Aircraft & Missile Catalog, Super T Teflon Bulletin S-3 or Super "TIP" Teflon Bulletin S-7.

31120



SALES OFFICES  
 Atlanta, Chicago  
 Cleveland, Dayton, Denver  
 Detroit, Fort Worth  
 Fort Worth, Kansas City  
 Louisville, Memphis  
 Miami, New York  
 Oklahoma, Philadelphia  
 Pittsburgh, San Diego  
 San Francisco, Seattle  
 Torrance, Tulsa

Circle Number 39 on Reader Service Card

**STOW FLEXIBLE SHAFTING  
FEEDS THE  
WORLD'S FAST-  
EST CANNON  
ON THE**

**WORLD'S  
FASTEST  
FIGHTER-  
BOMBER**



USAF All-Weather F-106 THUNDERCHIEF, world's fastest fighter-bomber, sent through sky at twice the speed of sound. Struts on the F-106 is the Valco Automatic Cannon, world's fastest machine gun, capable of firing 2000 M44 rounds a minute at the rate of 6000 rounds per minute. That's performance!

And right in there, power-driving the feed mechanism for the rapid firing Valco, they've got reliable Stow flexible shafting... designed by dependable performance drive components, tension, vibration and shock.



If you have a product requiring power drive, consider Stow flexible shafting—the design itself! Often it's the simplest, most dependable way to transmit power between non-collinear components.

For further information and complete details on Stow

flexible shafting, write for STOW Engineering Bulletin #627.



**STOW  
MANUFACTURING CO.**  
65 BUSHAW ST. BIRKINGHAM, N.Y.

Circle Number 40 on Reader Service Card

**NEW!  
TYMETER®** **24  
HOUR  
CLOCK**  
"Time at a Glance"

**\$15** 220-018

Here's the most dependable clock you've ever used! The quartz atomic in this 100% metal clock has 24 hour clock, contains all other work of time telling. Resistant to magnetic noise, strong sound, vibration, moisture and heat. Without an energy source, runs 24 hours. Price \$15.00 plus \$2.00 shipping and handling. 24 hour clock. 24 hour clock. 24 hour clock.

At Your Local Radio, or  
ORDER QUOTE FROM  
BIRMINGHAM

**TYMETER ELECTRONICS  
PENNSHORE MUMCHRON CO.**  
1210 HAZARDTOWN AVE. PITTSBURGH, PA.

Circle Number 41 on Reader Service Card

**Optical  
Domes  
Elements  
Windows  
Lapping  
Lightweight  
Mirrors  
Beryllium  
Mirrors  
Spherical  
Slicing**

**OPTICAL ENGINEERING  
SERVICES**

Special specifications  
For immediate completion  
**PRECISION LAPPING CO., INC.**  
54 Drexel Ave., Valley Stream, L.I., N.Y.  
Telephone: 675-1011

Circle Number 42 on Reader Service Card

An important announcement from



**To: Buyers of Stainless Steel Fasteners  
Re: Customer/Accommodation Services**

In an attempt to assist fastener buyers understand the factors that regulate pricing and delivery information, and clearly what satisfying "total requirements" actually means, ALLMETAL publishes the following Statement of Policy, and Guide to Buyers.

**C/A Service 1. — FULL STOCK ITEMS**

ALLMETAL stocks a full range of regular and special fasteners in full stock. Prices on these items are lower. But are controlled on non stock or limited stock fasteners, and dependant can be made accordingly by stock. Many new items are added to this list from time to time. We suggest that buyers contact the nearest ALLMETAL Sales Office for full stocking pricing delivery information.

**C/A Service 2. — LIMITED STOCK ITEMS**

ALLMETAL stocks a wide range of regular and special fasteners in limited stock. These fasteners typically require special good pricing rates and material quantities. ALLMETAL inventories limited stock items to accommodate its customers' short-term needs for immediate shipment. Stock at prices lower than non stock items. Again due to limited stock items, some new items being added constantly.

**C/A Service 3. — NON-STOCK ITEMS**

ALLMETAL can manufacture all sizes and styles of ALLMETAL "NON-STOCK" due to our extensive manufacturing facilities. These items are priced only slightly higher than stocked items, as a customer accommodation. We guarantee in writing, our ability to meet your requirements. We suggest whenever possible that buyers experienced in stocked items or style for best price and delivery. A call to any ALLMETAL Sales Office for an estimate regarding an item will bring prompt samples and quotations by return mail.

**C/A Service 4. — SPECIAL FASTENERS AND  
SPECIAL MACHINE WORK**

ALLMETAL can supply a wide full range of special fasteners and some machine work in stainless steel and all metals to meet your specifications. Many industry listed "specials" are manufactured regularly by ALLMETAL which allows the customer to call and order (stock) for this purpose. A quote will be sent to you immediately. We supply buyers with a complete list of "Specials" manufactured under ALLMETAL "part number". This list contains many different head styles and sizes types. For partial outlines are given "special" item price "total requirements" with a grid or specifications for ALLMETAL. General number including style, size and quantity needed.

**C/A Service 5. — GROUPED PURCHASES**

ALLMETAL under certain circumstances can group various head styles and sizes to assist a better customer price and delivery schedule. If number of our various items become orders we then grouped purchases can often cut down delivery time and price, especially on non-stock items. We suggest you check ALLMETAL list for 20 year stainless fastener match.

**C/A Service 6. — PRECISION MACHINE SCREWS**

ALLMETAL machine screws are a series of 100 of precision, "close tolerance", slightly machine screw in 10-10 type 303 stainless steel. These are stocked in 1000 and 2000, in many head styles and sizes, and are available for immediate shipment of items stock. ALLMETAL specializes in "precision" screws with the use of ground or finished equipment for the manufacture of stainless fasteners. New equipment and facilities are added to meet industry needs.

**MANUFACTURERS SINCE 1929**  
**ALLMETAL®**  
SPRIN PRODUCTS COMPANY, INC.  
MAIN PLANT: 821 STENNANT AVENUE, GARDEN CITY, N. Y.  
516 Pioneer 1-1200

**C/A Service 7. — MINIATURES AND  
SUB-MINIATURES**

ALLMETAL stocks a large part of standard fasteners in 1/8 and 3/16, plus 1/16 and 1/32. These represent the most complete list of all stock miniature fasteners. Fasteners require many items including 1/16, 1/32, 1/64, 1/8, 3/16, 1/2, 5/8, 3/4, 1, 1 1/2, 2, 3, 4, 5, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, 170, 172, 174, 176, 178, 180, 182, 184, 186, 188, 190, 192, 194, 196, 198, 200, 202, 204, 206, 208, 210, 212, 214, 216, 218, 220, 222, 224, 226, 228, 230, 232, 234, 236, 238, 240, 242, 244, 246, 248, 250, 252, 254, 256, 258, 260, 262, 264, 266, 268, 270, 272, 274, 276, 278, 280, 282, 284, 286, 288, 290, 292, 294, 296, 298, 300, 302, 304, 306, 308, 310, 312, 314, 316, 318, 320, 322, 324, 326, 328, 330, 332, 334, 336, 338, 340, 342, 344, 346, 348, 350, 352, 354, 356, 358, 360, 362, 364, 366, 368, 370, 372, 374, 376, 378, 380, 382, 384, 386, 388, 390, 392, 394, 396, 398, 400, 402, 404, 406, 408, 410, 412, 414, 416, 418, 420, 422, 424, 426, 428, 430, 432, 434, 436, 438, 440, 442, 444, 446, 448, 450, 452, 454, 456, 458, 460, 462, 464, 466, 468, 470, 472, 474, 476, 478, 480, 482, 484, 486, 488, 490, 492, 494, 496, 498, 500, 502, 504, 506, 508, 510, 512, 514, 516, 518, 520, 522, 524, 526, 528, 530, 532, 534, 536, 538, 540, 542, 544, 546, 548, 550, 552, 554, 556, 558, 560, 562, 564, 566, 568, 570, 572, 574, 576, 578, 580, 582, 584, 586, 588, 590, 592, 594, 596, 598, 600, 602, 604, 606, 608, 610, 612, 614, 616, 618, 620, 622, 624, 626, 628, 630, 632, 634, 636, 638, 640, 642, 644, 646, 648, 650, 652, 654, 656, 658, 660, 662, 664, 666, 668, 670, 672, 674, 676, 678, 680, 682, 684, 686, 688, 690, 692, 694, 696, 698, 700, 702, 704, 706, 708, 710, 712, 714, 716, 718, 720, 722, 724, 726, 728, 730, 732, 734, 736, 738, 740, 742, 744, 746, 748, 750, 752, 754, 756, 758, 760, 762, 764, 766, 768, 770, 772, 774, 776, 778, 780, 782, 784, 786, 788, 790, 792, 794, 796, 798, 800, 802, 804, 806, 808, 810, 812, 814, 816, 818, 820, 822, 824, 826, 828, 830, 832, 834, 836, 838, 840, 842, 844, 846, 848, 850, 852, 854, 856, 858, 860, 862, 864, 866, 868, 870, 872, 874, 876, 878, 880, 882, 884, 886, 888, 890, 892, 894, 896, 898, 900, 902, 904, 906, 908, 910, 912, 914, 916, 918, 920, 922, 924, 926, 928, 930, 932, 934, 936, 938, 940, 942, 944, 946, 948, 950, 952, 954, 956, 958, 960, 962, 964, 966, 968, 970, 972, 974, 976, 978, 980, 982, 984, 986, 988, 990, 992, 994, 996, 998, 1000, 1002, 1004, 1006, 1008, 1010, 1012, 1014, 1016, 1018, 1020, 1022, 1024, 1026, 1028, 1030, 1032, 1034, 1036, 1038, 1040, 1042, 1044, 1046, 1048, 1050, 1052, 1054, 1056, 1058, 1060, 1062, 1064, 1066, 1068, 1070, 1072, 1074, 1076, 1078, 1080, 1082, 1084, 1086, 1088, 1090, 1092, 1094, 1096, 1098, 1100, 1102, 1104, 1106, 1108, 1110, 1112, 1114, 1116, 1118, 1120, 1122, 1124, 1126, 1128, 1130, 1132, 1134, 1136, 1138, 1140, 1142, 1144, 1146, 1148, 1150, 1152, 1154, 1156, 1158, 1160, 1162, 1164, 1166, 1168, 1170, 1172, 1174, 1176, 1178, 1180, 1182, 1184, 1186, 1188, 1190, 1192, 1194, 1196, 1198, 1200, 1202, 1204, 1206, 1208, 1210, 1212, 1214, 1216, 1218, 1220, 1222, 1224, 1226, 1228, 1230, 1232, 1234, 1236, 1238, 1240, 1242, 1244, 1246, 1248, 1250, 1252, 1254, 1256, 1258, 1260, 1262, 1264, 1266, 1268, 1270, 1272, 1274, 1276, 1278, 1280, 1282, 1284, 1286, 1288, 1290, 1292, 1294, 1296, 1298, 1300, 1302, 1304, 1306, 1308, 1310, 1312, 1314, 1316, 1318, 1320, 1322, 1324, 1326, 1328, 1330, 1332, 1334, 1336, 1338, 1340, 1342, 1344, 1346, 1348, 1350, 1352, 1354, 1356, 1358, 1360, 1362, 1364, 1366, 1368, 1370, 1372, 1374, 1376, 1378, 1380, 1382, 1384, 1386, 1388, 1390, 1392, 1394, 1396, 1398, 1400, 1402, 1404, 1406, 1408, 1410, 1412, 1414, 1416, 1418, 1420, 1422, 1424, 1426, 1428, 1430, 1432, 1434, 1436, 1438, 1440, 1442, 1444, 1446, 1448, 1450, 1452, 1454, 1456, 1458, 1460, 1462, 1464, 1466, 1468, 1470, 1472, 1474, 1476, 1478, 1480, 1482, 1484, 1486, 1488, 1490, 1492, 1494, 1496, 1498, 1500, 1502, 1504, 1506, 1508, 1510, 1512, 1514, 1516, 1518, 1520, 1522, 1524, 1526, 1528, 1530, 1532, 1534, 1536, 1538, 1540, 1542, 1544, 1546, 1548, 1550, 1552, 1554, 1556, 1558, 1560, 1562, 1564, 1566, 1568, 1570, 1572, 1574, 1576, 1578, 1580, 1582, 1584, 1586, 1588, 1590, 1592, 1594, 1596, 1598, 1600, 1602, 1604, 1606, 1608, 1610, 1612, 1614, 1616, 1618, 1620, 1622, 1624, 1626, 1628, 1630, 1632, 1634, 1636, 1638, 1640, 1642, 1644, 1646, 1648, 1650, 1652, 1654, 1656, 1658, 1660, 1662, 1664, 1666, 1668, 1670, 1672, 1674, 1676, 1678, 1680, 1682, 1684, 1686, 1688, 1690, 1692, 1694, 1696, 1698, 1700, 1702, 1704, 1706, 1708, 1710, 1712, 1714, 1716, 1718, 1720, 1722, 1724, 1726, 1728, 1730, 1732, 1734, 1736, 1738, 1740, 1742, 1744, 1746, 1748, 1750, 1752, 1754, 1756, 1758, 1760, 1762, 1764, 1766, 1768, 1770, 1772, 1774, 1776, 1778, 1780, 1782, 1784, 1786, 1788, 1790, 1792, 1794, 1796, 1798, 1800, 1802, 1804, 1806, 1808, 1810, 1812, 1814, 1816, 1818, 1820, 1822, 1824, 1826, 1828, 1830, 1832, 1834, 1836, 1838, 1840, 1842, 1844, 1846, 1848, 1850, 1852, 1854, 1856, 1858, 1860, 1862, 1864, 1866, 1868, 1870, 1872, 1874, 1876, 1878, 1880, 1882, 1884, 1886, 1888, 1890, 1892, 1894, 1896, 1898, 1900, 1902, 1904, 1906, 1908, 1910, 1912, 1914, 1916, 1918, 1920, 1922, 1924, 1926, 1928, 1930, 1932, 1934, 1936, 1938, 1940, 1942, 1944, 1946, 1948, 1950, 1952, 1954, 1956, 1958, 1960, 1962, 1964, 1966, 1968, 1970, 1972, 1974, 1976, 1978, 1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018, 2020, 2022, 2024, 2026, 2028, 2030, 2032, 2034, 2036, 2038, 2040, 2042, 2044, 2046, 2048, 2050, 2052, 2054, 2056, 2058, 2060, 2062, 2064, 2066, 2068, 2070, 2072, 2074, 2076, 2078, 2080, 2082, 2084, 2086, 2088, 2090, 2092, 2094, 2096, 2098, 2100, 2102, 2104, 2106, 2108, 2110, 2112, 2114, 2116, 2118, 2120, 2122, 2124, 2126, 2128, 2130, 2132, 2134, 2136, 2138, 2140, 2142, 2144, 2146, 2148, 2150, 2152, 2154, 2156, 2158, 2160, 2162, 2164, 2166, 2168, 2170, 2172, 2174, 2176, 2178, 2180, 2182, 2184, 2186, 2188, 2190, 2192, 2194, 2196, 2198, 2200, 2202, 2204, 2206, 2208, 2210, 2212, 2214, 2216, 2218, 2220, 2222, 2224, 2226, 2228, 2230, 2232, 2234, 2236, 2238, 2240, 2242, 2244, 2246, 2248, 2250, 2252, 2254, 2256, 2258, 2260, 2262, 2264, 2266, 2268, 2270, 2272, 2274, 2276, 2278, 2280, 2282, 2284, 2286, 2288, 2290, 2292, 2294, 2296, 2298, 2300, 2302, 2304, 2306, 2308, 2310, 2312, 2314, 2316, 2318, 2320, 2322, 2324, 2326, 2328, 2330, 2332, 2334, 2336, 2338, 2340, 2342, 2344, 2346, 2348, 2350, 2352, 2354, 2356, 2358, 2360, 2362, 2364, 2366, 2368, 2370, 2372, 2374, 2376, 2378, 2380, 2382, 2384, 2386, 2388, 2390, 2392, 2394, 2396, 2398, 2400, 2402, 2404, 2406, 2408, 2410, 2412, 2414, 2416, 2418, 2420, 2422, 2424, 2426, 2428, 2430, 2432, 2434, 2436, 2438, 2440, 2442, 2444, 2446, 2448, 2450, 2452, 2454, 2456, 2458, 2460, 2462, 2464, 2466, 2468, 2470, 2472, 2474, 2476, 2478, 2480, 2482, 2484, 2486, 2488, 2490, 2492, 2494, 2496, 2498, 2500, 2502, 2504, 2506, 2508, 2510, 2512, 2514, 2516, 2518, 2520, 2522, 2524, 2526, 2528, 2530, 2532, 2534, 2536, 2538, 2540, 2542, 2544, 2546, 2548, 2550, 2552, 2554, 2556, 2558, 2560, 2562, 2564, 2566, 2568, 2570, 2572, 2574, 2576, 2578, 2580, 2582, 2584, 2586, 2588, 2590, 2592, 2594, 2596, 2598, 2600, 2602, 2604, 2606, 2608, 2610, 2612, 2614, 2616, 2618, 2620, 2622, 2624, 2626, 2628, 2630, 2632, 2634, 2636, 2638, 2640, 2642, 2644, 2646, 2648, 2650, 2652, 2654, 2656, 2658, 2660, 2662, 2664, 2666, 2668, 2670, 2672, 2674, 2676, 2678, 2680, 2682, 2684, 2686, 2688, 2690, 2692, 2694, 2696, 2698, 2700, 2702, 2704, 2706, 2708, 2710, 2712, 2714, 2716, 2718, 2720, 2722, 2724, 2726, 2728, 2730, 2732, 2734, 2736, 2738, 2740, 2742, 2744, 2746, 2748, 2750, 2752, 2754, 2756, 2758, 2760, 2762, 2764, 2766, 2768, 2770, 2772, 2774, 2776, 2778, 2780, 2782, 2784, 2786, 2788, 2790, 2792, 2794, 2796, 2798, 2800, 2802, 2804, 2806, 2808, 2810, 2812, 2814, 2816, 2818, 2820, 2822, 2824, 2826, 2828, 2830, 2832, 2834, 2836, 2838, 2840, 2842, 2844, 2846, 2848, 2850, 2852, 2854, 2856, 2858, 2860, 2862, 2864, 2866, 2868, 2870, 2872, 2874, 2876, 2878, 2880, 2882, 2884, 2886, 2888, 2890, 2892, 2894, 2896, 2898, 2900, 2902, 2904, 2906, 2908, 2910, 2912, 2914, 2916, 2918, 2920, 2922, 2924, 2926, 2928, 2930, 2932, 2934, 2936, 2938, 2940, 2942, 2944, 2946, 2948, 2950, 2952, 2954, 2956, 2958, 2960, 2962, 2964, 2966, 2968, 2970, 2972, 2974, 2976, 2978, 2980, 2982, 2984, 2986, 2988, 2990, 2992, 2994, 2996, 2998, 3000, 3002, 3004, 3006, 3008, 3010, 3012, 3014, 3016, 3018, 3020, 3022, 3024, 3026, 3028, 3030, 3032, 3034, 3036, 3038, 3040, 3042, 3044, 3046, 3048, 3050, 3052, 3054, 3056, 3058, 3060, 3062, 3064, 3066, 3068, 3070, 3072, 3074, 3076, 3078, 3080, 3082, 3084, 3086, 3088, 3090, 3092, 3094, 3096, 3098, 3100, 3102, 3104, 3106, 3108, 3110, 3112, 3114, 3116, 3118, 3120, 3122, 3124, 3126, 3128, 3130, 3132, 3134, 3136, 3138, 3140, 3142, 3144, 3146, 3148, 3150, 3152, 3154, 3156, 3158, 3160, 3162, 3164, 3166, 3168, 3170, 3172, 3174, 3176, 3178, 3180, 3182, 3184, 3186, 3188, 3190, 3192, 3194, 3196, 3198, 3200, 3202, 3204, 3206, 3208, 3210, 3212, 3214, 3216, 3218, 3220, 3222, 3224, 3226, 3228, 3230, 3232, 3234, 3236, 3238, 3240, 3242, 324



## GAUGE SAVINGS TWO WAYS IN EDGEWATER ROLLED STEEL RINGS

No matter how you look at an Edgewater ring, you see economies built right in—in materials, in machining.

The forming process matches the finished cross-section contour so closely that very little metal is wasted—especially important when costly alloys are used.

Each ring is hot-rolled so close to finish that little machining is ever needed—a key cost factor in any job.

Less waste saves material. For less machining time saves labor.

What do you need? A ring 5" O.D.—or 145"? For bearing races, motors, aircraft engines, turbines?

Consult the Edgewater man. He has a considerable bitful of information to help you beat the profit squeeze.

Or send for this free 12-page brochure telling why you get superior quality and save money, when you buy Edgewater rolled steel rings.

**EDGEWATER STEEL COMPANY**  
P. O. BOX 470, DEPT. A-10 S.T., PITTSBURGH 30, PA.



## SCINTILLATORS & NUCLEONIC INSTRUMENTS



### NEED PLASTIC SCINTILLATORS

Scintillator systems for beta and gamma ray detection. For X-ray, neutron and cosmic ray detection. For high energy particle detection. For low energy particle detection. For high energy particle detection.



### UNIVERSAL RADIATION MONITOR

A portable, rugged, and accurate radiation monitor. For gamma, beta, and alpha ray detection. For high energy particle detection. For low energy particle detection.



## NUCLEAR ENTERPRISES LTD.

3300 Bayview Avenue, Willowdale, Ontario  
M2H 1A1, Canada

Circle Number 43 on Reader-Service Card

strips  
in a  
breaze  
with  
one  
quick  
squeeze

cut tough Jellon® covered wire...for precise electronic and even required to pass high confidence level inspections

REPAIRS AND REPAIRS TO EQUIPMENT



## TRIP CUSTOM Stripmaster

Strip solid or stranded wire easily — with no wire nicks, insulation scratches — no waste or sparks. Compact matched blades, lifted to exact wire size by watchmaker's equipment, plus rotating action, lets you meet high confidence standards even on insistent insulation. Three models — for Type K Teflon, Type K2 Teflon and general purpose plastic and fiberglass insulation. Sizes for 10 to 14, 16 to 20, or 22 to 30 wire. Optional transparent view stop adjusts to strip exact insulation length. Read coupon for full information.

IDEAL INDUSTRIES, INC.  
1037 Park Ave., Syracuse 10

Please send me the free copy of  
Product Wire Stripping Catalog  
and this article's coupon immediately  
at Service using form 100-1000

Name \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_



# DYNAMICS RESEARCH CORPORATION

presenting an advanced concept in... Optical Shaft Angle Encoders — **OPTISYN®**

**OPTISYN** is a high-accuracy incremental encoder and decoder for precise control of shaft position, shaft rate, and direction of shaft motion. It is available in three basic configurations: absolute, incremental, and high-speed. The absolute version provides high-speed, high-precision position, rate, and direction information. The incremental version provides high-speed, high-precision position, rate, and direction information. The high-speed version provides high-speed, high-precision position, rate, and direction information.



**NEW INCREMENTAL OPERATIONS**  
Incremental encoders are inherently simpler and easier to use. They are available in three basic configurations: absolute, incremental, and high-speed. The absolute version provides high-speed, high-precision position, rate, and direction information. The incremental version provides high-speed, high-precision position, rate, and direction information. The high-speed version provides high-speed, high-precision position, rate, and direction information.

**OPTISYN OPERATION**  
OPTISYN is a non-contact optical encoder and decoder. It uses a laser beam to measure the position, rate, and direction of shaft motion. The absolute version provides high-speed, high-precision position, rate, and direction information. The incremental version provides high-speed, high-precision position, rate, and direction information. The high-speed version provides high-speed, high-precision position, rate, and direction information.



**RELATIVE APPLICATIONS** include analysis of shaft position, rate, and direction. They are used in a variety of applications, including motion control, position sensing, and rate sensing.

**INDUSTRIAL APPLICATIONS** include analysis of shaft position, rate, and direction. They are used in a variety of applications, including motion control, position sensing, and rate sensing.

**STANDARD MODELS**  
OPTISYN is available in three basic configurations: absolute, incremental, and high-speed. The absolute version provides high-speed, high-precision position, rate, and direction information. The incremental version provides high-speed, high-precision position, rate, and direction information. The high-speed version provides high-speed, high-precision position, rate, and direction information.

	OPTISYN-100	OPTISYN-1000	OPTISYN-10000
Resolution	10 to 1000	1000 to 10000	10000 to 100000
Speed	1000 to 10000	10000 to 100000	100000 to 1000000
Shaft Position	10 to 1000	1000 to 10000	10000 to 100000
Shaft Rate	1000 to 10000	10000 to 100000	100000 to 1000000
Shaft Direction	10 to 1000	1000 to 10000	10000 to 100000
Shaft Acceleration	10 to 1000	1000 to 10000	10000 to 100000
Shaft Deceleration	10 to 1000	1000 to 10000	10000 to 100000
Shaft Jerk	10 to 1000	1000 to 10000	10000 to 100000
Shaft Shock	10 to 1000	1000 to 10000	10000 to 100000
Shaft Vibration	10 to 1000	1000 to 10000	10000 to 100000

All models have a resolution of 10 to 100000 and a speed of 1000 to 1000000. They are available in three basic configurations: absolute, incremental, and high-speed. The absolute version provides high-speed, high-precision position, rate, and direction information. The incremental version provides high-speed, high-precision position, rate, and direction information. The high-speed version provides high-speed, high-precision position, rate, and direction information.

**ABSOLUTE OPERATIONS**  
Absolute encoders are inherently simpler and easier to use. They are available in three basic configurations: absolute, incremental, and high-speed. The absolute version provides high-speed, high-precision position, rate, and direction information. The incremental version provides high-speed, high-precision position, rate, and direction information. The high-speed version provides high-speed, high-precision position, rate, and direction information.

**OPTISYN OPERATION**  
OPTISYN is a non-contact optical encoder and decoder. It uses a laser beam to measure the position, rate, and direction of shaft motion. The absolute version provides high-speed, high-precision position, rate, and direction information. The incremental version provides high-speed, high-precision position, rate, and direction information. The high-speed version provides high-speed, high-precision position, rate, and direction information.

**RELATIVE APPLICATIONS** include analysis of shaft position, rate, and direction. They are used in a variety of applications, including motion control, position sensing, and rate sensing.

**INDUSTRIAL APPLICATIONS** include analysis of shaft position, rate, and direction. They are used in a variety of applications, including motion control, position sensing, and rate sensing.

**STANDARD MODELS**  
OPTISYN is available in three basic configurations: absolute, incremental, and high-speed. The absolute version provides high-speed, high-precision position, rate, and direction information. The incremental version provides high-speed, high-precision position, rate, and direction information. The high-speed version provides high-speed, high-precision position, rate, and direction information.

## FILTERS

For...  
• HYDRAULICS  
• PNEUMATICS  
• THERMAL



Golden Standard filters and strainers for hydraulic, pneumatic, and thermal applications. They are used in a variety of applications, including motion control, position sensing, and rate sensing.



Western Filter Co. Inc.  
1001 S. WILSON ST. CHICAGO, ILL. 60606  
TELEPHONE (312) 321-1000  
Cable Number: 47 or Radio Service Card



ORBITING ASTRONOMICAL OBSERVATORY

To Simulate 200 miles up... at Grumman



SPACE SIMULATION SYSTEM

CG 100

...temperatures from +350°F to -320°F  
...vacuum to  $1 \times 10^{-7}$  mm Hg

How do you perform the necessary payload thermal vacuum tests of the OAO (Orbiting Astronomical Observatory) to assure reliability? That was the question faced by Grumman Aircraft Engineering Corporation, prime contractor to NASA for the OAO.

The 10 ft. dia. by 28 foot test chamber shown is the heart of the space simulation system designed and built by Chai. The high vacuum pumping system can lower

pressures below the  $10^{-7}$  mm Hg range. The low temperature of outer space can be simulated by a liquid nitrogen cold wall. The nitrogen systems also include equipment to heat and circulate gaseous nitrogen for thermal testing, and a vaporizer-heater for emergency

heat-up of the nitrogen shroud. Chai is ready to attack any testing requirement you may have—with a "world of experience" to offer. Chicago Bridge & Iron Company, Oak Brook (Hawthorne P. O.), Illinois Offices and subsidiaries throughout the world.

**CB&I** built it!

Circle Number 48 on Reader Service Card



Need Remote Mechanical Controls?

USE ARENS STANDARD-DESIGNS. Distribute "high cost specialty"

See us first... and you will probably find the control you are looking for. Some the time and expense of having a special custom design dropped because one of Arens' standard designs will provide the same requirements. And it cost you no shipping and assembly in payment will be placed in such such you as special controls for your application. Write us your requirements.

**ARENS CONTROLS, INC.** 3001 Desmarre Road, Evanston, Illinois

Circle Number 46 on Reader Service Card

# DIRECT-CURRENT SOLENOIDS shaped to fit!



THE CONVENTIONAL THE COMPACT THE WAFFER



1" or 1 1/2" dia. D.C. or 120V AC Long or short stroke Push or pull Pull force up to 1000 lbs. (rated) (5000 in-lb)

1 1/2" x 1 1/2" dia. D.C. or 120V AC Long or short stroke Push or pull Pull force up to 1000 lbs. (rated) (5000 in-lb)

1 1/2" x 1 1/2" dia. D.C. or 120V AC Long or short stroke Push or pull Pull force up to 1000 lbs. (rated) (5000 in-lb)

Standard shaped solenoids available from stock parts. Other products: Miniature Valves—Orifice Valves—Manifold Valves.

MANUFACTURING DIVISION OF  
**KOONTZ-WAGNER** 240 N. MICHIGAN ST.  
MICHIGAN CITY, INDIANA 46340

Circle Number 21 on Reader Service Card

## CIRCLE ESS BIG 3

Over 100 STANDARD "FLEXIBLE SHAFT" COMBINATIONS

Thousands of Pre-Designed "FLEXIBLE SHAFT" Special Combinations  
Experienced in Design a "FLEXIBLE SHAFT" Combination for Your Specific Application

\* All Circle 3s Flexible Shaft Combinations Available with Motor-Driven or 1/2-Horsepower Motor



**F.W. STEWART CORP.**

1000 E. 10th Street, Des Moines, Iowa 50319

Circle Number 46 on Reader Service Card

# MOBILITY SPECIALISTS

Commercial & Military  
Specifications

United Kingdom: One example—three examples and more—designed to meet the most exacting requirements of both our Commercial and Military customers. These examples are your guarantee of dependable performance.



Research & Development  
We custom build the products or have produced the designs. United's experienced engineers can help you.

THE UNITED MANUFACTURING CO.  
1110 Delaware Ave.  
Cleveland 3, Ohio

THE UNITED MANUFACTURING CO.  
1110 Delaware Avenue  
Cleveland 3, Ohio

☐ Please send a United Sales Engineer

☐ Send United literature only

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

Circle Number 23 on Reader Service Card

Circle Number 47 on Reader Service Card

cool comfort  
for avionic  
hot-spots



Nothing like a 1-a.m. cool drink of dielectric fluid to keep miniaturized electronic systems on the job when there's not enough space or air to protect them against overheating.

Eastern liquid cooling systems for avionics take over where heat sinks, convection or fan-cooling leave off. These simple, lightweight, compact packs are completely self contained — no pumps, heat exchangers, pipes, controls. They give the designer of avionics the kind of help he needs for superheats and hypervisors.

vehicles, for missile support equipment.

Recent low-cost applications of Eastern liquid cooling packs for avionics systems: Nike Ajax, Hercules, Zeta, Hawk and Menakem. That's pretty fast company to be in.



Interested?  
Send for  
Bulletin 370.



## EASTERN INDUSTRIES

A DIVISION OF LABORATORY FOR ELECTRONICS, INC.  
100 SKIFF STREET • HAMDEN 14, CONNECTICUT



## SIMULATION

**Motion • High Vacuum • Temperature • Radiation • Known conditions of space**

flight are faithfully reproduced through experienced analysis, design, manufacture, and construction of aerospace simulator facilities. CompuDyne is one of very few companies qualified to assume complete responsibility at every stage. Depend on the capabilities of CompuDyne. CompuDyne Corporation, Hatboro, Pa.

**CompuDyne Corporation:** computer-operated automatic control systems and related electronic, hydraulic, and mechanical instrumentation for the aerospace and industrial process fields.

Circle Number 49 on Reader Service Card

## AVICA for fluid system components



**AVICA-FLEX® Metal Bellows and Bellows Assemblies**  
For use in both high and low pressure fluid and vacuum systems, these bellows assemblies provide reliable performance in both high and low pressure systems.



### AVICA® Mechanically Attached Tube Fittings

The ability to provide a reliable seal in areas of high pressure and high temperature is a critical factor in fluid system design. AVICA's mechanically attached tube fittings provide a reliable seal in both high and low pressure systems.

Designed by AVICA to meet the critical requirements of the aerospace industry, these fittings are available in both high and low pressure systems. They are designed to provide a reliable seal in both high and low pressure systems.



### AVICA-FLEX® Flexible Metal Tubing Assemblies

Designed for a wide variety of applications, these flexible metal tubing assemblies provide a reliable seal in both high and low pressure systems.

AVICA provides the critical components for fluid systems in both high and low pressure systems.

**WRITE TODAY!**  
For more information, contact AVICA today.

AVICA Corporation  
10000 N. 10th Street  
Scottsdale, AZ 85258

Circle Number 50 on Reader Service Card

## AVICA CORPORATION

P. O. Box 100 • Phoenix, Arizona 85001  
Telephone: (602) 944-1000

Circle Number 51 on Reader Service Card



*MATCHED TO THE JOB!*



New turb-hull Sikorsky helicopter, powered by gas turbine, carries seven passengers loads comfortably.

GM-Harrison plate-fin type heat exchanger, all constructed in General Motors facilities, high standards of quality and reliability.

## GM-HARRISON CONTROLS CRITICAL TEMPERATURE FOR NEW TURBINE-POWERED HELICOPTER

**EXPERIENCE** is the vital key to critical heat transfer problems. In designing temperature control equipment, GM-Harrison engineers draw on a rich fund of knowledge acquired in many fields . . . aviation, aerospace, automotive, marine, and industrial. This broad experience, coupled with a complete line of basic designs, is the reason why Harrison heat exchangers are so precisely **MATCHED TO THE JOB** . . . to provide an ideal combination of performance, reliability and economy.



HARRISON RADIATOR DIVISION • GENERAL MOTORS CORPORATION, LOCKPORT, NEW YORK

Circle Number 49 on Reader Service Card





#### NUCLEAR-IN-SPACE MATERIALS TESTING

### Wide Range of Neutron Energy, With Tailored Neutron-to-Gamma Ratio, Produced Amid Temperatures from 2800°C to -253°C

Complete General Electric nuclear facilities can provide the exacting environmental conditions needed to test materials for America's nuclear-space hardware. With test reactors now operating, General Electric's Valletos Atomic Laboratory can tailor open-reactor and pyro-nuclear environments—environments created through selection of neutron energy, neutron-to-gamma ratio, and by temperature control. Experimental planning is simplified by complete facilities for materials examination and experiment fabrication. A unique capability of the fully integrated laboratory is the speed of investigation and reporting of results—made possible by full chemical-metallurgical capability and on-site post-irradiation examination equipment. General Electric Co., Valletos Atomic Laboratory, P.O. Box 448, Florence, Calif. 94601

GENERAL  ELECTRIC

## Message From the Publisher

### Concerning This Issue

Aviation Week & Space Technology is proud to present a Buyers Guide issue which combines perspective reports on the key facets of aerospace procurement with a roll call of aerospace companies in the United States, Canada, the United Kingdom and Western Europe, plus the most comprehensive compilation of sources for products and services available to the aerospace industry.

A significantly greater number of companies and organizations are represented in this year's Buyers Guide issue as well as a greatly expanded list of products, reflecting the industry's growth as new aerospace companies are formed, and as firms long established in other industries venture into the field of aerospace technological developments.

The 56-page Products and Services Section names some 3,000 suppliers of more than 2,000 products and services, including research, development, test and engineering organizations as well as manufacturers and suppliers of basic materials. Information in this section is right up to date as the result of a massive industry survey conducted by Aviation Week & Space Technology.

#### Engineer's Role

As we pointed out in the first Buyers Guide issue, published in mid-December, 1955, the engineer is a key individual upon whom the initial responsibility for organizing buying and selling falls. Good purchasing and good selling starts at the preliminary design stage.

The growing acceptance of the Buyers Guide issue since 1955 is a matter of record. Readership checks conducted to determine the use which is made of the Buyers Guide issue found that this publication is referred to in increasing frequency by engineering management people in connection with their aerospace assignments. The mid-December, 1963, Buyers Guide issue documents almost all the products and services which, in the aggregate, constitute the \$17-billion aerospace market.

One obvious way in which the Buyers Guide issue can be of proven usefulness is in forming out new sources of supply. An Aviation Week & Space Technology pointer out in an article concerning production of the Sidewinder, when Navy selects a second source for

a weapon such as this air-to-air missile, it insists that the new contractor develop a different group of subcontractors and vendors whenever practical. This means that the continuing advantages of competition will be established at several levels: in the production structure and not merely at the prime contractor level.

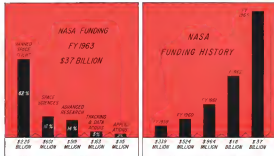
Another advantage of this weeding out of new sources is that it broadens the industrial base and makes production less vulnerable to natural and man-made interruptions. It is in precisely this area of finding new suppliers that the Buyers Guide issue can play an important role—by creating an awareness of hitherto untapped sources and resources.

#### Vital Concepts

The Buyers Guide issue takes on particular importance at this time, when value analysis and value engineering should be fully accepted as vital concepts of profitable aerospace technology. Increasing interest on the part of the Defense Dept., General Accounting Office and Reconnaissance Board in the cost of aerospace procurement demands greater ingenuity and diligence in obtaining the most technological progress with the most efficiency and economy. Secretary of Defense Robert S. McNamara in an advisory to the military services, stated that "we should ruthlessly eliminate all activities the cost of which is not commensurate with their contribution toward national defense." And the National Aeronautics and Space Administration, faced with a deficit of \$300 million while at the same time preparing a near-\$5-billion budget request for Fiscal 1964, can be expected to turn a sharp eye to trimming excess cost out of its procurement.

Here, then, is your Buyers Guide issue, our final aerospace issue in 1963—a year which has proven to be a record one for Aviation Week & Space Technology in such things, in advertising volume and in worldwide acceptance. We are certain that not more than 10,000 net paid subscribers, as well as those countless thousands of additional readers throughout the aerospace world, will find it as exceedingly useful and practical industry tool.

—Robert W. Martin, Jr.,  
Publisher



CHARTS REVEAL H&A's dominant funding emphasis on social programs left, and mostly growing local funding elsewhere.

## NASA Foresees \$5.5-\$7 Billion Budgets

Re Edward H. Kalman

National Aeronautics and Space Administration foresees a gradual leveling trend in the amount of money it will receive to conduct the U.S. space program, but the budget anticipated in the immediate future continues to place the space agency in the category of big business. The level of effort during the next decade is expected to range between \$5.5 and \$7 billion annually and the space market will continue to be highly competitive.

Major portions of these funds will be spent, according to NABA Administrator Dwight Albert F. Seper, in the engineering development of space hard ware—launch vehicles, spacecraft, flight instruments and the ground-based facilities to build, test, launch and track flight hardware. Seper illustrated this point with a breakdown of the \$3.7 billion appropriation for the current year. Fiscal 1963.

• **Construction of** oil-and-gasland facilities will total \$772 million, 50% of the total appropriation. About \$771 million represents the launch facility, including and launching complex. Remaining of the construction money is being spent this way: spacecraft and satellite navigation research facilities, \$120 million; landing and communications facilities, \$45 million; and several laboratories to track and acquire data from space vehicles.

In major landing areas, NASA will spend \$62 million. Space agencies will spend \$100 million. Space agencies will spend \$100 million. Space agencies will spend \$100 million.

\* **Research, development and operations** financing, which totals nearly \$3 billion and provides an additional \$1 billion for development and joint use flights of launch vehicles, \$1 billion for development and on board experiments, \$525 million to support the NASA agency, and \$135 million for the launch vehicle.

hardware programs through a series of projects, which currently total about 40. Their range in effort from the billion-dollar Saturn C-5 and Apollo space craft projects to smaller single flight experiments on sounding rockets. Since the Apollo program began, landing program was made a national goal list issue by President Kennedy, those projects within the broad category of direct or indirect support for Apollo are those which will be given top national and top NASA funding and scheduling priority.

All NASA centers are involved to some degree in the manned lunar landing program, and most NASA business with contractors flows directly from the agency's field installations, which oversee primary control of the specific projects. However, each center maintains its own budget and resource lists for supplies, research and services that it buys.

The program is essentially the same as that used by Defense Dept., which set the pattern for NASA's procurement regulations.

Although NASA continually emphasizes its intention to keep the aerospace market highly competitive, the agency has initiated a two-step com-

positive results on the higher expenses  
incurred at schools.

This process involves a pre-proposal deadline conference, open to all who believe they qualify to compete, and then a formal industry conference to discuss the project and the agency's needs. Preparing this hardware specification, NASA actually reads two or three conceptual study contracts on a project, from which the agency then chooses the contractor to develop the more detailed specifications. This has done so on the Apollo spacecraft competition, and is continuing with chairman studies of the Nova reactor and the laser studies to drive spacecraft and portland cement rockets. The agency also has a distribution web or services that are closely guarded; the project will be formally abstracted and requests for bids will go out to the companies named as the most qualified, but awarded by the contractor.

Negotiated procurement is a technique NABs use when the project cannot be defined by detailed specifications. Again, the source list is the basis for selecting companies with which the agency will negotiate.

• **Fixed-price, most frequently used:** both in formally advertised bids and negotiated procurements. In this category are lump-sum contracts employed for support of research. Because of the research nature of NASA's work, more contracts will probably be composed of special stipulations with price ceilings and maximum clauses.

• **Cost**, which is used when research and development activities produce a sale in the scope of the contract. Normally, this contract type involves a direct reimbursement at a fixed fee. Although the fee may be negotiated in dollars, this fee averages 6-7% of the total contract award.

Major procurement problems NASA faces involve poor estimates made by the agencies in developing programs, and equally poor estimates which industry makes in responding to NASA bid requests. Estimates in the past have been considerably low, which has caused some program delays in the current fiscal year.

Following is a summary, prepared by NASA, of its negotiations with the industry which encompasses all the contracts which encompassed all the

### Headquarters, Portsmouth

The Headquarters Procurement Branch of the Procurement and Supply Division is responsible for planning, negotiating, awarding and administering contracts based on procurement requirements initiated by and under the technical competence of the Headquarters staff and program offices. Such requirements include, but are not limited to liquid hydrogen, reliability studies, the critical phases of research and develop-

ment projects, consultant advising services, mobile lecture demonstrations, loans, exhibits, motion picture services, assessment analysis, surveys, and various consultant and professional services. In addition, this branch is responsible for negotiating and awarding all NASA contracts with foreign government and foreign commercial organizations.

Excluded from the branch's procurement responsibilities are the following office supplies and services, furniture and equipment, magazine subscriptions, printing, reproduction, graphic arts services, and other Headquarters support type items which are the responsibility of the Administrative Services Division, and research grants and university research which are the responsibility of the division of Grants and Research Contracts.

## Missed Spacecraft Center

The Manned Spacecraft Center located in Houston, Tex., was created in 1959 in the Space Task Group and charged with carrying out Project Mercury and other NASA manned space flight programs. In January, 1961, it became a separate NASA field element and

In October, 1968, Space Task Group returned a move to Texas and became officially known as Manned Spacecraft Center. It is expected the move to the new site presently under construction in the Houston area will be completed by early 1969.

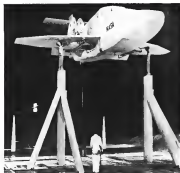
Manassas Spaceport Center handles include investigations into man's performance capabilities and ability to survive in a true space environment. The program uses a research and development facility for unmanned sub-orbital and orbital flights and recovery, to simulate flight. It operates the largest technical space laboratory and environmental chamber in the world and conducts all various aspects of manned space flight capabilities, including space guidance and communication systems, orbital rendezvous, re-entry and recovery systems, and biological and medical research. It also designs and builds all the hardware, equipment and facilities used in the program and is located in their category, actual space rockets used by launchers is considered flight in other space activities.

Marshall Spaceflight Center is also responsible for Gemma, follow up to Project Mercury, which will carry two men on an earth orbital flight, and Project



### Sphere Used in Communication Satellite Studies

**Sphere Used in Communication Satellite Studies**  
Two spheres, 115 in dia., is being used by National Aeronautics and Space Administration to test in designing new probe communication satellites. Spheres is one of a series built by Goodyear Corp. of Azusa, Calif. Division, Azusa, Calif., for testing in NASA and USAF space-communication vacuum chambers. It is constructed of rigidized, expanded aluminum wire mesh laminated between two sheets of polypropylene covering



**XV-5A Model Tested in Wind Tunnel**

Full-scale wind-tunnel model of Army's XV-5A tiltrotor aircraft is shown before tests at NASA's Ames Research Center. XV-5A, formerly designated VZ-11 (AW Aug 26, p. 32), was produced by the tilt rotor mounted in the wing for V-22, the first and only tiltrotor. It is expected that the tilt rotor will multiply thrust of the two GE J85 turbines by 300% for vertical flight.

Apello, which will follow Project Gemini, with extravehicular and lunar landing missions.

#### Marshall Center

The Marshall Space Flight Center oversees much of facilities and personnel transferred under agreement from the Army Ballistic Missile Agency and other Army organizations at Redstone Arsenal, Ala. The center occupies 1,120 acres adjoining the city of Huntsville. Its facilities are valued at approximately \$180 million. The center has charge of developing and operating NASA's launch vehicles, and conducting related research.

Technical functions of the center are divided among nine laboratories. Activities include investigations of aerodynamics and related sciences, propulsion and data reduction, production of experimental models and prototype components and research in manufacturing methods and technology, the design and pilot development of guidance and control systems and structure and launching of boosters and space vehicles.

Typical projects at the Marshall

Space Flight Center include development of the Saturn vehicle, the F-1 engine, the F-2, 200,000-lb liquid hydrogen engine, the RL-10, the V-1 and the H-1 engines. Marshall also handles the tilt rotor in flight test project for the Space Nuclear Propulsion Program.

The Marshall Assembly Plant at New Orleans and the Mississippi Test Facility are part of the Marshall Space Flight Center complex, and operations conducted there are under the administrative direction and responsibility of the center, although most of the work carried on is under contract to various industrial organizations.

#### Jet Propulsion Laboratory

The task of exploring the moon and the planets is the major responsibility of NASA's Jet Propulsion Laboratory. The facility was transferred to NASA from the Army Ordnance Missile Command in December, 1958, and is operated under contract by the California Institute of Technology.

Research at JPL is advanced through eight technical divisions and

covers the broad spectrum of activities associated with space programs, including propulsion, aerodynamics, chemistry, guidance, communications, planetary mathematics, and many other related fields.

Although JPL is operated under contract, a full-time NASA policy which encourages subcontracting tasks to industry. It is expected that in the near future 75% of the JPL contract funds will be awarded to outside organizations.

#### Space Nuclear Propulsion

The Space Nuclear Propulsion Office was established as a joint activity of the Atomic Energy Commission and the National Aeronautics and Space Administration so that the needs of common interest carried out by groups in each agency would be coordinated and merged in a single unit to develop the application of the nuclear rocket to space missions.

In accordance with the statutory responsibilities of both agencies, the ARS will have primary responsibility in this program for the development of nuclear reaction fuel use in conjunction with flight missions specified by NASA. NASA will have primary responsibility for research and development of non-nuclear components and the integration of the reactor and non-reactor components into complete engine systems and vehicles involved in the various space projects which include nuclear power or propulsion.

This office is responsible for all aspects of Project Rover including development of the Nova engine, advanced technology, test facilities, vehicle development and motor development. Inquiries with respect to these and other projects involving nuclear energy should be addressed to either the Headquarters Office of Communications, Ltd., or the Division Office at the Los Alamos Research Center.

#### Langley Research Center

The Langley Research Center is primarily concerned with the conduct of research related to the problems associated with space flight and entry from space into planetary atmospheres, and problems of entry and ascent.

In the area of space flight and atmospheric entry, Langley Research Center activities include work on lift, thrust, materials, structures, and guidance and control of vehicles and space craft, ballistic missiles, entry vehicles, and homing and winged space vehicles.

Aerodynamic problems investigated at Langley are applicable to military and commercial vehicles of all types—missiles, bombers, interceptors, reconnaissance, transport, and orbital aircraft—leading (VTOL) and short take-

off landing (STOL) airplanes, and ground effect vehicles (GEMs) which permit large vehicles to ride on a cushion of air.

Typical projects at the Langley Research Center include: experimental techniques employing the high speed, high temperature environment of the tunnel; space research and development; structural research related to high speed airplanes, missiles and spacecraft; studies of bone fluid mechanics including microcirculation and the characteristics of gases at high temperature; development of special structures capable of withstanding high temperature; lifting, design and development of specialized research in structures; supporting research in specific development projects for both NASA and other government organizations including Motors, Motors, Motors and R & D, and development of a number of launch vehicles for research purposes including the four stage, suborbital Scout.

#### Ames Research Center

The Ames Research Center, with an extensive background in high speed aerodynamics, is currently making important contributions in basic and applied research on both aerodynamic and space flight problems.

Approximately one-third of the center's programs are directly applicable to space. Space travel oriented programs are concerned with atmospheric re-entry, re-entry vehicles, boost gliders, rocket powered aircraft, orbital launch and lunar craft, ballistic missiles and lift support. These include a wide variety of commercial studies and the development of highly specialized simulation apparatus as well as research, both basic and applied, in subsonic and supersonic flow. The Langley Research Group studies many areas concerned by other researchers in the U.S., including hypersonic (extra-atmospheric lift and side motion), environmental biology (microbiology, pathology, physiology, radiobiology) and biotechnology (application of biological data in engineering problems and systems).

The remaining portion of the Ames research effort is concerned with the fundamentals of aerodynamic and supersonic aerodynamics and the problems of vertical and short takeoff and landing aircraft.

Typical projects at the Ames Research Center include: orbital attitude stabilization of an advanced meteorological satellite, stabilization and control for an orbiting astronomical observatory, studies of the ability of a human pilot to control a space vehicle during "steady" design operations for re-entry vehicles, wind tunnel and flight research on vertical and short takeoff and landing aircraft, instrumentation and sensor

techniques and devices, and studies of military and civilian aircraft in the future.

#### Goldard Center

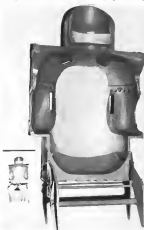
The Goldard Space Flight Center is a broad-based center. It is charged with the responsibility for complete development programs in (1) space science and satellite applications and (2) tracking and data acquisition and collection involved in the multi-faceted satellite that are various programs to research and develop regarding experimental techniques of control and the ability to forecast problems, anticipate needs and plan long range application of new developments. The effort is directed to maintain technical proficiency in a fast changing scientific area and to provide back-up support for monitoring larger government programs accomplished through industrial contractors. A com-

plex, environmental test and analysis program is operated by the center for the small satellites and to perform flight simulation testing on the large observation-type spacecraft.

The space science program develops both basic and applied scientific research with emphasis on astronomy and astrophysics, geophysics, atmospheric physics, lower sciences, planetary and interplanetary sciences, magnetic fields and fields, and the ionosphere.

The applications program, under contract, research and development with technology and communication satellites.

In tracking and data acquisition and reduction the center is the tracking and communication link of the world-wide network and Alouette satellites. For the second generation of scientific satellites now approaching the center is designing and building data acquisition



**Mercury Seat Modification Shows**

Photo shows modification of the astronaut seat in the McDonnell Douglas space capsule for the Navy OTC White Star's M1A in orbit flight Oct. 8, p. 20. Seat modification at left shows control and which incorporated by project.

stations with giant 85-ft parabolic antennas. For manned space flights Goddard has designed and operates a global chain of stations which provide vital tracking, telemetry, and ground voice communications on a "real time" basis. The focal point of this system is Goddard's space control center: north-determines and predicts satellite orbits, collects scientific and spacecraft data and transmits a voice network linked to 18 stations in the Mexican network.

In Goddard's theoretical program studies are being conducted in interplanetary vehicle mechanics, the nature of planets, the moon's surface and structure, and the atmospheres of the earth and planets. The Goddard Institute of Space Studies was established May 1, 1958, in New York City. The purpose of the institute is to conduct basic theoretical research in the space sciences in collaboration with universities in that state.

The theoretical effort at the Goddard has shifted from the universe's in that it is more closely related to NASA projects and experimental activities with special emphasis being placed on studying energetic particles and magnetic fields in space.

#### Lewin Center

The Lewin Research Center is primarily responsible for basic and applied research in astronautical and space propulsion and power generation.

The effort is divided into two major areas: chemical rocket engines, electric rocket engines, electric propulsion systems, power generation systems and space environmental effects.

Typical projects at Lewin include high speed propellers for rocket nozzles, effects of icing on propeller stages and pumping systems, propellant systems for "wet" lower landings, direct conversion of heat to electricity,

electrical rocket engines for space propulsion, materials and heat transfer research related to nuclear rocket systems, certified and experimental studies of fluid machinery involving pumps, turbines and heat exchangers, and transportation of materials, lubrication and wear and corrosion systems.

The Lewin Research Center operates the Plum Brook Station at Sandusky, Ohio. This facility consists of a full-scale water cooled nuclear reactor, hot laboratories and supporting facilities which provide the means to carry out engine evaluation programs in addition to research and development on energetic pumps, turbines, turbo-pumps, gas generators, propellant tanks, hot nozzles, system dynamics, nozzles, control systems and heat transfer studies.

#### Western Operations

Levin's responsibilities for NASA general activities located west of Denver is centered at the Western Operations Office, Santa Monica, Calif. This office provides liaison on the West Coast for industry and research organizations on one hand, and for NASA Headquarters and field installations on the other.

Western Operations Office administers NASA contracts, performs technical consulting and liaison on NASA contracts or projects and advises headquarters on technical developments and capabilities in the area. The office also handles associated security, legal and patent matters and auditing.

#### Wallops Station

Wallops Station's present-day function is to conduct experiments with rocket propelled vehicles carrying payloads used for astronomical and space research. These payloads may be in the form of rockets or space flight models, models of manned space capsules or manned lunar orbiting and other sounding devices in an other space research device capable of being carried by the vehicles which Wallops Station launches. Occasional research is conducted at Wallops Station with two full instrumented payloads or models dropped from aircraft, in addition to ground launched research vehicles.

Up to seven rocket stages have been used to launch research payloads from Wallops Station. Missiles have flown higher than 5,000 mi. above the Atlantic Ocean and at speeds as great as 20,000 mph for the purpose of space flight research. Thus far, more than 4,500 payloads have been launched at Wallops, with over 100 research vehicles being launched each year. The biggest of these research vehicles launched at Wallops Station is the boost sounding rockets are customarily being launched at this station.

Facilities are available at Wallops

## NASA PROCUREMENT OFFICES

National Aeronautics and Space Administration, Washington 25, D. C.

Ernest W. Brendert, WO 3-7549

John M. Berry, WO 3-7535

Director, Procurement and Supply

Industry Liaison Officer

#### HEADQUARTERS PROCUREMENT BRANCH

1400 E. Street, N.W., Washington 25, D. C.  
Telephone: WO 3-7549

#### AMES RESEARCH CENTER

Mail Stop 100, Ames, Iowa, California

Telephone: WO 3-7549

1. Allen J. Herring

2. Gerald E. Smith

3. Tom McGinnis

#### FLIGHT RESEARCH CENTER

Box 232, Dayton, Ohio

Telephone: WO 3-7549

1. Edward S. Hight Jr.

2. William C. Frazier

#### GOVERNMENT SPACE FLIGHT CENTER

Washington, D. C.

Telephone: WO 3-7549

1. Gordon A. Taylor

2. John T. Smith

#### JET PROPULSION LABORATORY

California Institute of Technology

4800 Oak Grove Drive, Pasadena 3, Calif.

Telephone: WO 3-7549

1. W. Dennis

2. Gordon A. Lawrence

#### LANGLEY RESEARCH CENTER

Langley Station, Hampton, Virginia

Telephone: WO 3-7549

1. Robert L. Butler

2. John T. Smith

#### LANGSTON OPERATIONS CENTER

Langston Station, Fairfax, Virginia

Telephone: WO 3-7549

1. Robert L. Butler

2. John T. Smith

#### LEWIS RESEARCH CENTER

1000 Broadway Road, Cleveland 20, Ohio

Telephone: WO 3-7549

1. Edward S. Hight Jr.

2. William C. Frazier

#### MANNING SPACE FLIGHT CENTER

Wallops Station, Virginia

Telephone: WO 3-7549

1. Gordon A. Taylor

2. John T. Smith

#### GEORGE C. MARSHALL SPACE FLIGHT CENTER

Redstone Station, Alabama

Telephone: WO 3-7549

1. Robert L. Butler

2. John T. Smith

#### NORTH EASTON OFFICE

30 Somerset Drive, Cambridge 40, Mass.

Telephone: WO 3-7549

1. Robert L. Butler

2. John T. Smith

#### SPACE RESEARCH ESTABLISHMENT OFFICE

ARC Headquarters, Greenbelt, Md.

Telephone: WO 3-7549

1. Robert L. Butler

2. John T. Smith

#### Wallops Station

Wallops Station, Virginia

Telephone: WO 3-7549

1. Gordon A. Taylor

2. John T. Smith

#### Wallops Operations Office

100 Broad Street, Santa Monica, California

Telephone: WO 3-7549

1. Gordon A. Taylor

2. John T. Smith

1. Procurement Officer

2. Chief Business Specialist

Station to gather research data from such vehicles. Wallops Station is presently engaged in testing and receiving various types of data from the Titan space shuttle now in orbit and will continue to be the prime tracking and command station for the remainder of the Titan program.

In addition to radar and telemetry data, most tests are supported at Wallops Station with photographic coverage and optical tracking facilities. If necessary, optical instruments can be released from outside agencies to support the intended equipment available at this station. For recent tests, the observation of the atmosphere as detected either just before or immediately after a specific launching by means of extensive sounding balloons, radio balloons, and rocket probes. Wallops Station is a primary center for the launching of research models for the study of hypersonic and space flight problems. Preliminary investigations and studies for Project Mercury were conducted at this station.

#### Flight Research

Tailwind flight research, including such fields as aerodynamics, heat stresses, operating problems and the mechanism of flight in the atmosphere is the task of the NASA Flight Research Center.

In addition to analytical programs, the Flight Research Center operates an extensive flight evaluation program equipped operational and experimental aircraft. A major program at the center

was in the X-15, designed to verify some data on extreme altitudes and speeds.

A major flight program involves technical studies for research rocket propulsion and performance on the flight program of the post USAF NASA (X-15) program.

While the major effort at the Flight Research Center is directly associated with the X-15 program, additional research includes prediction of hypersonic aerodynamic characteristics through scaling correlation techniques and comparative wind-tunnel investigation of the handling qualities of subsonic military and commercial aircraft, and

radio and telemetry support for flight programs.

#### Launch Operations

Launch Operations Center serves as the NASA point of coordination for the preparation and submission of all requirements for launch support and organization with outside range officials to fulfill such requirements.

The newly established procurement office is charged with the responsibility to make and administer contracts for all supplies, materials and services including construction, necessary for support of the Launch Operations Center and other NASA organizations.



Rift Material Tested at Lockheed-Georgia

Scientists at Lockheed-Georgia's Georgia Nuclear Laboratories check the first segment of material for the Titan rocket in flight test program. Segment included control cables, mechanism for lift propellant tank and several types of altimeters.



Gemini Simulator Aids Systems Design

Simulator for the Gemini (Gemini) spacecraft is being used by NASA and McDonnell Aircraft Corp. Gemini ground controllers, as used in evaluating designs for operational systems. The simulator is wired to existing computers and a 7090 computer at McDonnell.

# DOD Begins Incentive Systems, Combines

By Larry Rooda

Washington—Two actions taken in the past year by the Defense Dept. will greatly affect procurement policies of the major departments and the individual services. First was the establishment of the Defense Supply Agency (DSA). The second was the issuance of changes in the Armed Services Procurement Regulations (ASPR), effective Dec. 1, which strengthens the government's hand in administering incentive type contracts.

Changes of DSA deal together the general procurement of the military services. The broad categories covered are automotive supplies, traffic management, logistics management, electronics, construction, industrial supplies, petroleum, medical supplies, clothing and textiles, scientific and general.

DSA procurement covers standard items which are usually sold to the public and do not need to be developed. Most of the contracts covered by DSA are of the fixed price type with several bids and award to the lowest bidder.

The ASPR changes affect the other end of the procurement spectrum. This involves research, development and procurement of weapons systems and related items which are unique. Many of these procurements cannot be awarded for by the open bid system. Many are covered by security agreements. In most instances, these are, by each one contract, qualified to do a job. This results in the necessity for negotiating contracts.

The ASPR changes have been the subject of considerable discussion for more than a year. Basically, Defense Dept. has wanted to encourage economy in weapons system contracts by providing for incentive fees in opposition to cost plus fixed fee and similar contracts where costs are not strictly controlled. It was suggested that the central aim was to allow fees to range from 15% profit to as much as minus 5% penalty for poor performance.

The result of these annual ASPR changes is that government now makes the decision of fees in lowering of prices under a great variety of conditions, but there is little restriction of government for estimating prices or fees for good performance.

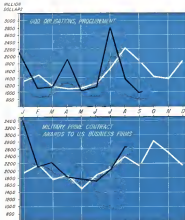
The ASPR changes will advance to some extent Defense Secretary Robert S. McNamara's aim to achieve economy in the procurement of expensive weapons systems. As they now stand they can be described as one-sided. If a contractor should, by superior management, achieve substantial economy, the ASPR provides for adjustments.

But this is only the first move toward to meet service. The Reorganization Act permits the Reorganization Board to enter the picture at some later date to determine whether excessive profits were made. If such a determination is

Board will find no fault in the profits made by contractor.

The system are incentives for government action taken after Nov. 10, 1962. Dispositions are in cases where there has been formal advertising and the bids have been opened, but award of a contract is not possible before Dec. 1. However, contract offers in such instances are directed to try to satisfy the new clauses by mutual agreement.

Contractors under which a contract can be negotiated, rather than opened to bidding, are described in the new ASPR, Section 3-214. In general, contracts can be negotiated when a service section decides that procurement of technical or special programs requires a substantial initial investment in an extended period of preparation for manufacture, and when



SOURCE—BUREAU OF THE SERVIC  
DEFENSE procurement obligations and prime contract awards are compared by month for calendar year 1961 (solid line) and part of 1962 (dashed line).

# Some Buying

he believes that an award through bidding would increase the cost to the government by displacing the incentive.

Examples of the types of material covered under this procedure are aircraft, tanks, radar, guided missiles, rockets, major components of these items, and new supplies of a technical or specialized nature. Such procurements usually involve high starting costs which may have already been paid for by the government previously engineering and development work already completed in order to speed testing already acquired, considerable time and effort expended in prototype development, or important design changes which will continue to be developed by the supplier.

When some or all of these conditions prevail, they form the basis for placing a production contract with the supplier who developed the requirement. This means the government takes the benefit of technology, testing and development already acquired by the supplier, either at his own or government expense.

A cautionary note is added in the statement that this procedure should not be used to avoid duplication of private investment unless this duplication would be likely to result in additional cost to the government.

In drawing that a contract should be negotiated the service secretary said make sure that the supplier comes under the categories described above and that changing suppliers would result in additional cost to the government or perpetuate loss.

Pricing and cost analysis techniques are described in the new Section 3-507. It offers rules in which contractors' proposals can be evaluated and how the contracts can be negotiated.

Some form of price or cost analysis must be made with every negotiated contract. If the contracting officer sees that there will be adequate price competition, the analysis of costs does not have to be as thorough. If price competition does not exist, then he may require cost data to be submitted. Price is described as what the customer pays for goods or services. Cost is defined as what the supplier must pay to deliver the goods or services.

Price analysis is the process of examining and evaluating prospective price data without reference to the contractor's cost data. This can be done by comparison of price quotations submitted by competitors of previous quantities and current prices with current quotations for the same or similar items, taking into account fluctuations in specifications, quantities delivered and



CONSIDERABLE RESEARCH on the principle of variable wing wings, which will be used by the Dept. of Defense F-16 fighter program, was carried out by the National Aeronautics and Space Administration. Among the configurations tested at the Full Scale Wind Tunnel at the Langley Research Center was this one of a supersonic aircraft employing a large outboard of the wing leading to wing sweep. This system reduces mechanical complications and eliminates large stability changes that might otherwise occur.





ROYAL THAI ARMY soldiers using U.S. equipment in assault training exercises. Two OH-107 helicopters are operating with an FV60: Comp. M113 as transportable around personnel camp.

delivered from the site of rough work-study such as dollars per pound, per horsepower or other units comparison with published price lists quoted on a competitive basis and published market prices, comparison of proposed prices with estimates at cost which have been independently developed by the purchasing activity.

Price analysis can be used to determine the reasonableness of awards without cost analysis whenever there is adequate price competition.

#### Cost Analysis

Cost analysis, as distinguished from price analysis, is the process of obtaining a breakdown of cost from prospective contractor or subcontractor. This process is broken down into verification of cost data, the evaluation of specific elements of cost and the projection of these data to determine the effect on price of each factor is properly, reasonable of amounts estimated, allocation the characteristics, the basis for allocation of overhead costs and the approximation of overhead cost allocation to the contract.

Actual costs previously incurred by the contractor must be compared with his low price cost estimate for the same or a similar item.

Evaluation must include current cost estimates from other sources and price estimates in historical data of other manufacturers making the same or similar items.

For the historical cost experience, the making of forecasts of future trends is considered important. Trends must be spotted when costs are either going up or down, especially for labor and materials.

A contractor must submit cost or pricing data and certify that it is so-

source complete and current prior to the award of any of these contracts.

- Cost-estimation type, estimate or price adjustable contract regulation of dollar amount.
- Any five fixed price or fixed price with escalation negotiated contract expected to exceed \$100,000.
- Any contract modification expected to exceed \$100,000 to any fixed or adjustable or negotiated contract, whether or not cost or pricing data was required in connection with the initial pricing of the contract.
- Any negotiated contract not expected to exceed \$100,000 in amount or in



HEAVY LIFTED helicopter. McDonnell International Helicopters is loaded aboard a USAF Military Air Transport Service Douglas C-119 Comanche during a test of the loading system. McDonnell weighs more than 35,000 lb.

contract modification not expected to exceed \$100,000 to any fixed or adjustable or negotiated contract whether or not cost or pricing data was required in connection with the initial pricing of the contract, provided the contracting officer who has jurisdiction considers that the circumstances warrant such action.

The subject of what happens when defective cost or pricing data is submitted, or the award to submit any, is treated in the next section. Essentially it says that the government can adjust price when such a condition exists.

#### Purchasing Practices

Cost analysis is referred to subcontractors is covered in depth in Section 5107.10. It explains that, when a large percentage of price contract deliver to his services raw materials and parts, it is necessary for the prime contractor to have efficient purchasing practices.

While the prime contractor is basically responsible, the contracting officer must be able to know whether the subcontractor is performing their work efficiently.

Proposals of price estimates include three "make-or-buy" proposals and proposed subcontractors. The contracting officer answers this package to determine the purchasing practices of the prime contractor, the proposed subcontractors to be subcontracted including the degree of competition in obtaining them, the cost and price indices by the prime contractor on the proposed subcontractors, and the extent of subcontract.

experience the types of subcontract the estimated total extent of subcontracting, including procurement of gas contract of parts and materials.

The ASPR says that it is the duty of a prime contractor to undertake price analysis of all significant subcontract transactions and when competition does not exist or is minimal to conduct cost analysis. Thus the burden passes to the prime contractor from the contracting officer. In instances where the consent of the contracting officer is required for award of a subcontract price or cost analysis is mandatory.

Many subcontracts are subject to review for possible underestimation of price in order to avoid excessive profits. Generally, speaking, prime contract prices should not be negotiated before the subcontract prices have been settled in some instances where subcontract cost data is fairly low, the contracting officer can proceed with negotiations.

Section 5109.42 deals with a variety of audit procedures. Major differences exist in the clauses inserted in contracts concerning audit procedures. In almost every instance, however, the government must have the right to audit for three years after termination of a contract and that it has the right to examine the books, accounts, documents and other supporting data which would permit adequate verification of the cost or pricing data submitted. The right extends to the contracting officer and the U.S. Comptroller General or their representatives.

#### Adjustment Clauses

The same section also contains clauses to be inserted in contracts which dictate the manner for price adjustment and adjustment to both prime contracts and to subcontracts made necessary for a variety of reasons.

Section 5109 states the conditions which apply to the determinations and findings of the contract sections. In general, the special conditions applying to negotiated contracts over \$100,000 must go to the lowest level for final decisions. The rules governing price review is negotiable as promulgated in Section 5101.

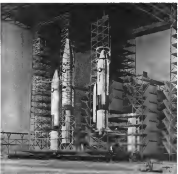
Other ASPR changes emphasize that all contracts for supplies and services, with certain stated exceptions, shall be made by formal advertising. Price competition is the key item in the general policy statement of Section 2.101.1.

The Defense Supply Agency (DSA) began operations in 1962 as a single management agency of the Defense Department. Other major single management agencies are the Defense Intelligence Agency (DIA), the Defense Communications Agency (DCA), and the Defense Atomic Support Agency (DASA).

In addition to the actual procurement functions of the contract requiring to



ARTOT's CONCEPTION of final assembly operations of the proposed Air Force X-15. The building also shows other elements of the on-site testing operations controlled by the project. USAF 4244, standard space launching system. All elements and parts of the United Technology Corp. 1150s solid propellant motor are to be used (shown) as far as can be found in an existing of a new Air Force site complex at Cape Canaveral, Fla. They will be moved to an adjacent Solid Motor Assembly Building for joining with the first other segments that comprise each part of strap-on and booster. Mating of the two solid propellant boosters to the X-15 is to be done in the building. After the two boosters are mated, the entire assembly will be moved to the building, where it will be mated to the X-15. Special equipment required includes handling ramp, air tunnel, lifting system and high capacity overhead crane, special "air-lift" system for moving the segments over the access, and specialized lifting transporter with heavy rollers.



line, the DSA director has the responsibility for coordinating supply cataloging, standardization of items produced, evaluation and disposal of surplus supplies. He also conducts aerial study and control at improving integrated supply and inventory systems for the Defense Dept.

During the current year, DSA will manage an inventory averaging \$2.6 billion, make calls to the services of \$1.1 billion and buy \$2.9 billion of new supplies. It will manage 1.1 million acres by the end of June, 1968, and provide service for four million of them. Annual expenditures will total about 18 million. By the end of the fiscal year, it will employ about 25,000 persons.

The troubled schedules that were set last January will result in DSA managing most management of all major defense materiel by next July 1. Else business management will follow during Fiscal 1969.

#### New Headquarters

DSA is planning to move its city headquarters to Fort Collins, Colo. It has completed studies of industrial production equipment and consumer goods supplies and has started a pilot study in accounting supply paths.

The headquarters staff occupies a converted warehouse at the Army's Contract Station supply center at Alexandria, Va.

Here is what DSA plans to do in the next future:

- **Detail analysis and simplified procedures** in procurement by using automatic data processing for inventory, performance and evaluation and applying them to data flow. There will be increased emphasis on quality control, testing and new competition to reduce the cost of supplies.
- **Implement the DSA data-bank system** while at the same time reducing the number of locations at which duplicate stocks are being maintained.
- **Improve the volume of stock-sharing** among the services in place of new procurement.
- **Speed the process of standardization** in order that the Federal Civilian goods law be controlled.
- **Screen off proposed new items** to control their entry into the system.

Army Lt. Gen. Andrew T. McNamara is the director of DSA and Army Adm. Joseph M. Lyle, USAF USAF, is deputy director. The remainder of the headquarters staff is made up of civilians and officers from all of the military services.

After DSA is well on its inventory management, the headquarters group that has had the most influence will continue to have in the next future in the Assistant Directors for Plans, Procurement and Services. This group covers the type of information Gen. Mc-

Nam needs to run the organization. The principal aim of this group is to reduce the time that a taken item takes to reach from the bottom to the top of the integrated supply organization. Historically, supply matters have tended to bog down into inadequate and slow information transfer. The information system is the answer.

The reasonably studied new being made by the plans group are aimed at determining whether the new contractors are the logical ones to have and whether the items they handle are in the right place.

The system has learning only a pilot study in accounting supply paths. It is difficult to identify complex items for the more highly complex require on time as well as cost because such are less common development. It must be determined whether a pilot study can do the same job in another system. It will take a long time to draw a common line.

Electronic parts are in such the same category as mechanical parts. The problem is not as complex, however, and a common catalog will be completed soon.

The establishment of a standard distribution system is another function that the plans group is accomplishing. Its plan is to begin increasing the rate of the rate of the individual services that it will reduce. It has an aim at a variety of operations from the services themselves and policies that control the pattern in local activities are distributed risk along in activities in new projects. The argument that common will make a need to overcome such operations.

#### Small Business Help

Small business is gaining an increased amount of attention from the Defense Dept. Defense expenditures account for more than half the total for the whole government. Through the Small Business Administration, the government is providing an increased amount of defense business to small enterprises, either through direct buying and contracting or through subcontracting (see p. 76).

Since the average small business does not have the capital or talent to compete in highly sophisticated research and development programs it is recommended that the subcontracting program be established in this type of work is desired. Many small businesses with a single technical talent can participate through working with a prime contractor.

Some research and development work can be done directly by the Defense Dept. through the major laboratories operated by the military services. In such instances, the organization which has such contracts has a specialist in small

business who is the focal point for its assistance.

Regardless of the approach taken, contractors are expected to be fully qualified from the standpoint of being required to defend. Government is, in general, expected to perform the type of contract that is having properly known personnel, good accounting methods and an involvement in the physical itself. There can be exceptions to this, however. Many small businesses offer only specialized research and development work. These are growing more popular with defense procurement agencies to solve highly technical problems that are not in the line of business. The performance of contracts in such cases the contractor does not have the specialized talent.

If a small contractor is working directly on a defense project, he will need working capital to acquire the necessary equipment to start work and to keep going before the work is completed. In such a case it is the interest of the government to provide a financial assistance. This help can come in a variety of ways. It can come through guaranteeing a loan, advance payments, accelerated payment payments or a combination of these.

**Class Inspection**

In making for the Defense Dept., agencies, the small contractor must be prepared to accept close inspection of his work. If the release of business work is, inspection is intended full time in the contractor's plant. Otherwise, it is on a part-time basis as sufficient work is received. Inspection can also be done at the point of delivery or final destination.

Government specifications are the inspector's guide. He has the first responsibility to inspect and report completed work. Thus it behooves the small contractor to assure that his quality control in production is sufficiently strict to allow the work to pass inspection. A high volume of rejected material can result in a loss of profits if the contracting officer refuses to allow rejected stock.

Most government contract specifications are built around a set of published standards on quality, size, performance, selection, packaging and testing. Every prospective contractor should have in hand the Index of Military Specifications, which can be obtained from the Superintendent of Documents. Many contractors fail to read and understand the specifications, but fail to correct standard specifications.

General information on defense contracting can be obtained from the Contract Administration Relationship Office, Assistant Secretary of Defense for Information and Logistics, Room 3E321, The Pentagon, Washington 25, D.C.

Some research and development work can be done directly by the Defense Dept. through the major laboratories operated by the military services. In such instances, the organization which has such contracts has a specialist in small

## Two Commands Handle Buying for USAF

**Washington**—Applied research, development and production for the U.S. Air Force is the responsibility of the Air Force Systems Command (AFSC), which was formed in 1961 to coordinate the service's weapon system procurement.

After research became operational, responsibility for their supply and maintenance shifts to the Logistics Command. (See research) is the responsibility of the Office of Aerospace Research.

Headquarters, AFSC, performs a plan and coordinating function. Actual contract with industry is maintained by the divisions and centers. Each of these entities has management responsibility for the projects under its responsibility.

Placement members of the Systems Command reflect the policies set by the Armed Forces Procurement Regulations and the Air Force Deputy Chief of Staff for Systems and Logistics. Control of procedures starts from these sources.

These are the last general areas of procurement planning acquisition of Air Force weapon systems.

Basic research The Office of Aerospace Research conducts all work to be done in this area. Projects concern the fundamental information associated with educational institutions and foundations and government laboratories participate in basic research programs. U.S.

costs and cooperation with the National Aeronautics and Space Administration. Future USAF manned space systems, other than those mentioned above, are the responsibility of ASD.

• **Support procurement** Supplies, services and continuing support for weapon systems come under the Logistics Command (ATL). After a weapon system becomes operational AFSC relinquishes its responsibility to the operational command which is then reported by AFSC. Replacement spare parts, inspection, maintenance, repair and modification must be accomplished by AFSC, where headquarters is at Wright-Patterson AFB, Dayton, Ohio.

• **Basic procurement** Supplies and services including maintenance are contracted by the individual specifications of the various Air Force operational commands to the U.S. and overseas. In the U.S., these commands are the Air Force Air Command, Tactical Air Command, Training Command, Air Defense Command, Military Air Transport Service, the Headquarters Command and the Military Air Command. Each institution has its own small business program.

AFSC and AFSC account for the



**WAYS BEING C-130 jet transport vehicles utilizing supplies at Fort Benning Airport, Colorado, during the emergency shift to Tulsa (AFW) base, p. 18). Support equipment was flown to by MATS Lockheed C-130s and Douglas C-124s from Fort and Europe.**











# AIR TRANSPORT



PARTS AND MATERIALS for the construction of a single B-737, such as American Airlines, will cost approximately \$25-\$30 million annually.

## Airline Purchasing Rate Climbs Annually

By James R. Attkisson

New York—Airline purchasing, which reaches billions of dollars a year for a vast variety of products, is increasing at a rate between 7.5% annually, according to industry experts.

Airlines are generally bulk buyers, negotiating merchandise that runs into millions of dollars. In one respect they view themselves as a "captive" market, since many of the items they require are supplied by federal standard and availability from a limited number of suppliers.

This is particularly so with engines, aircraft systems and engines. Once an aircraft and engine are bought, the manufacturer becomes the source of all replacement parts, including cockpit instruments.

"There are some cases where we use buy items directly from the original manufacturer, provided it is consistent with FAA specifications for the aircraft or engine and we have been certified to install it," says Lee Glasgow, vice president of purchasing and supply for American Airlines. "But for the most part, we buy through the aircraft or engine manufacturer."

Each procedure means that the original design and installation specifications are maintained.

Violating existing rules is necessary for support of the airline industry,

however, a wide variety of merchandise. An airplane seat is one example.

Only the seat frame is built by the seat supplier, who concentrates on design for strength and comfort. Rebird materials like upholstery, cushions and seat belts come from subcontractors or preferably, engine makers.

Definition of "captive" buyers does not apply, however, to the broad area of airline purchasing outside the aircraft and engine market. Between 48-45% of airline expenditures in the United States go into passenger items, such as airport space and facilities for ticket and baggage offices.

Glasgow says American's three largest expenditures are for fuel, \$60-\$65 million annually, aircraft and parts, \$25-\$30 million, and food \$17-\$18 million.

America, like all carriers, spends its fuel purchasing over a number of oil companies. Glasgow says oil companies must by necessity of jet use deliver a greater than any single company could supply.

"We pay about 12 cents per gallon for jet fuel," Glasgow says. "An aircraft on a transcontinental flight will burn about 50,000 lb, or 15,000 gal."

The large expense for materials comes from the frequent replacement nature of much airline equipment, such as tools to maintain the fleet, instruments for navigation and other materials.

"Our pricing bill alone for air-

borne, materials, ticket fares and other such items runs about \$15 million a year," Glasgow says. "It would be even higher if we didn't have our own print shop at La Guardia Airport."

Airlines practice centralized buying, maintaining a central supply point and supplying their various through supply chain orders. Airlines don't have to deal with thousands of suppliers, although it may ease purchase orders for a full year to provide lead time.

"Our volume of purchases has been increasing between 7.5% a year," Glasgow says. "At the same time, prices have been advancing about 5% annually, and we expect this rate to continue for the next five years or more."

Expenditures by airlines are high partially because of the large cost of their fleets. They need Glasgow calls the constant speed airplanes for as an aircraft's gross weight, which is driven by the engine.

"You can build it to your needs," he says, "and it costs \$12,000—the price of two Cessna's."

Glasgow cites the aircraft main purchasing problem as being inventory, with the added difficulty of obsolescence due to rapidly advancing technology.

"Our spare parts inventory runs about \$60 million," he says, "and it appears it will go to \$80 million."

He says the airlines are constantly

moving to get the aircraft and engine manufacturers to maintain this inventory for the carrier, the same as is done in automobile builders.

"If you're the commercial field and you're in the position as a carrier for aircraft," Glasgow says. "And since the aircraft manufacturers are one party to the contract, the manufacturer is reluctant to provide the service part for commercial buyers."

Glasgow says the airlines must anticipate a good lead time when ordering parts, since the engine and aircraft manufacturers won't reduce the supply procedure until they have the carrier's purchase order in hand.

Airlines act, working collectively through the Air Transport Association to improve parts procurement procedures. Most planned lead times developed in ATA's Specification 208 plan, which is industry data processing techniques are used in controlling a carrier's purchasing program.

Most of the major aircraft suppliers are already using the system, as an example of the larger airlines. The use is expected to become more widespread in the industry during 1983.

Specifications 208 should help align the flight lead time, now required to 60 orders. Lead time now averages 350 days from many suppliers, and the airlines think it should be no more than 30.

Better coordinated purchasing programs should also enable a reduction in the cost of spare parts. Many parts manufacturers, airlines complain, insist on producing individual job lots, rather than in lot for a group of orders and then mass produce. Larger quantity production would help lower costs and would also facilitate stock inventory for needed the refueling fuel.

As an alternative to spare production, airlines, working through ATA, have asked suppliers to keep at least a small supply of the most frequently needed parts on hand. For those of lower demand, they and the materials could be maintained to speed production. Little response, has been to the request, airlines sources say.

Airlines admit that some of their parts supply problem is self-inflicted. In the main, purchases of the same, or cut complex, their individual needs reduce and system installations in the carriers cost between suppliers of the same manufacturer. This opens the situation where parts manufacturers must fill orders in individual lots.

Glasgow says that carriers are at last coming around to more standardized airplanes—the Boeing 737 being the latest example. The 737's purchased by American, TWA, United and Eastern will be more alike than any other aircraft since jets were introduced, he says.

Individual characteristics of each airline's planes have caused each carrier to maintain its own parts inventory. TWA, for example, stocks approximately 200,000 with about parts for its mixed fleet of Boeing and Comair jets and Lockheed Constellation planes still in use.

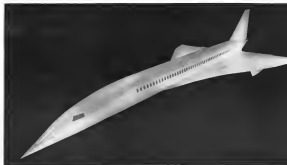
This large inventory is the main reason why airlines face a big backlog of spare parts, Glasgow says. "When we converted our fleet from turboprop to turbojet engines we had to carry \$16 million in parts such as water injection systems and sound suppressors."

"Sound suppressors cost the airlines approximately \$25,000 apiece regularly, or \$12,500 per engine."

With the airlines rapidly converting to turbojet power, carriers are faced with no alternative but to carry the expensive devices.

To eliminate these costs are increasing, Glasgow says the forward engine wing for the original transport in prices over \$4,200. We learned on bill the other day for 25 spare cooling fans for the turboprop propellers. It was for \$22,900 apiece.

There are under ten among airlines to achieve cost through parts pooling, thereby reducing expenditures. However, Glasgow says, the industry's structural requirements will continue to grow, making it an increasingly vital element in the carrier's picture.



## Model Shows Configuration of Anglo-French SST

Proposed Concorde Mark 22 transport under development is a joint English-French design and manufacturing team, will eventually come at \$9 to \$10 million. Aircraft would be built by British Aircraft Corp. and British Aerospace, with support from both governments.



## Do you want quality? Do you want reliability?

### STARTERS

**Air Turbine**, built for most large turbine engines today, are designed to operate using either ground equipment or mounted from either engine already running on a turboprop aircraft. While many use hydraulic, engine starting and accessory drive, are not being replaced.

**Bil-Gar Turbine Starters** provide fast and self-contained starting. Bendix Drive powered the fuel-air combustion starter are being used throughout the world.

**Direct Cranking Electric Starters** for aircraft have been built for Bendix for more than 15 years. Bendix provides an aircraft type split completely waterproof for use in conditions off the road vehicles.

### PUMPS

**Variable Displacement Hydraulic Pumps.** A typical example is a pump rated at 1.5 gpm at 2000 psi pressure and at 1000 rpm. It is capable of complete reversal of the flow flow. It has negative control quick action of the piston type motor in the system.

**Air Pumps.** The Bendix Ultra air pump is designed primarily for use in pneumatic drive systems. All demands to allow the driver loads and maintain to operate instruments, and to prevent automatic inflation of the brake, is furnished from this unit.

### FLEXIBLE POWER TRANSMISSION SHAFTS AND COUPLINGS

The Bendix Ultra model duplicate type flexible joint makes this shaft or coupling ideally suited for high-speed operations. No lubrication is required for the power transmitting members. Over three thousand of these shafts are now in field use. Some units have incorporated almost three thousand hour service without maintenance.

### HOT GAS GENERATORS AND PRIME MOVERS

Designed for marine and open vehicle applications, the Bendix Ultra hot gas generator will supply constant pressure over a proportional flow range pressure up to 500 to 1. The flow of the hydrogen generator is controlled through a pneumatic actuator system.

### ICE PREVENTION AND ELIMINATION SYSTEMS

The pneumatic de-icing system is approved for all types of wing conditions. The system consists of air pumps, pressure regulating valves, pressure and vacuum valves, check valves, air regulators, drains, distribution valves, and other similar items required to make the service of a specific aircraft.

### AIR TURBINE DRIVE ACCESSORIES

**Generators.** A Bendix Ultra leading air turbine generator, capable of operating with air inlet temperatures of 1000°F, supplies all the AC and DC power for the F10 aircraft. The design of drive from non-rotation on these units has proven their dependability.

**Constant Speed Drive.** Drives with integral control systems, capable of maintaining a constant output speed within plus or minus 1/2%, are common in power plants. They will operate for an unlimited period of time at 2000 G confidence.

**Fuel Pumps.** Turbine-driven centrifugal fuel pumps for all other burner or open engine fuel supply have been built at Bendix Ultra. The two-stage turbine permits removal of the unit and, in the event the pump is utilized during emergency, primary fuel supply can be built on an integral part of the pump.

**Water Injection Pumps** are designed with the same two-stage turbine feature to provide emergency use in the fuel pumps. Pressure relief valves are built into the unit to provide over pressure in the system.

### PNEUMATIC VALVES

Pressure reducing valves for use in 2000 psi systems have demonstrated their dependability for the thousands now in the field service use. Check valves for use in similar high-pressure systems are also available.

### FREEZE-PROOF PORTS

Freeze-proof fittings for limited aircraft operation are now available from Bendix Ultra. They are essential for applications exposed to the hard winters of space. They are all metal and require no lubrication. They are insensitive to dirt and are not affected by wide temperature range.

## See us.

Would you like to have more information on these aircraft products? Write us in Utica, New York. Export: Bendix International, 205 E. 40th Street, New York 17. West Coast: 117 S. Prentiss, Burbank, Calif. Canada: Aviation Electric, Ltd., 250 Lawrence Blvd., Montreal, Quebec.

**Bendix Ultra Division**



## BUSINESS FLYING



PRODUCTION of Piper Chieftain is carried out at Piper's new facility at Van Hook, Pa.

## Business Flying Grows as Major Market

By Edwin J. Baltes

**Dallas, Tex.**—General aviation today is a \$2-billion per year business—consisting of aircraft, fuel, oil, parts, supplies and services.

About 75,000 operating airplanes in the general aviation category annually log more than triple the number of hours flown by U.S. scheduled commercial airlines and are by far the greatest users of the nation's airports and communication and navigation facilities.

Domestic travel of these general aviation airplanes and flying hours is tracked from the business flying category—airplanes utilized by corporations and companies, distributors, salesmen and medical and business people.

Business airplane activity for 1978 fell five per cent from 1977, but it more than half the 12 million-plus hours logged by the total general aviation sector last year. And it is the segment of the general aviation market that the business aircraft manufacturers, sales and service companies have lived the most active years.

Manufacturers have more than tripled the dollar volume and total delivery volume of private airplanes in the past decade in exploring the need of businessmen for private or transportation. Only the year ago the customer had a choice of 15 models. Today the list is much more than 40 models with approximately one third of them rated as executive aircraft.

All signs point to general aviation, and business flying in particular, going up—up—up. Bock Aircraft Corp., one of the more conservative agencies of the industry, predicts that the general business airplane population will double in the next 10 years.

Plans to fill several new projects of 200 plane capacity per month, a Bock executive points out. Additional equipment for selling, handling and servicing this volume clearly points toward the need for facilities for pumping considerable additional quantities of fuel and oil, equipment for towing these airplanes about shops and to service them, and additional facilities to accommodate these passengers.

To handle their products and build sales volume, the manufacturers seek to double their current number of distribution and dealers in the country over the next few years. To this could be added the more fixed base operators who are enlarging their facilities or expanding the number of bases they operate.

The extent to which the business aircraft service business has grown can be understood by looking at the operations of one of the larger companies, 30-year-old Southwest Airlines Co. of Dallas, which now has a payroll of \$3 million.

Diversified to include jet and piston engine aircraft for the military and airlines, and with a parts distribution

### Business Aircraft Sales and Forecasts

1978	\$ 25,143,000
1981	\$ 31,917,000
1986	\$28,000,000
1991 (est.)	\$400,000,000
1996 (est.)	\$250,000,000

Based dollar volume, over 1980-1988 is based on deliveries reported by manufacturers to Airframe Industries Inc. Year following are based on industry projections.



these  
skilled  
hands  
can be  
yours ...

#### for DESIGN, DEVELOPMENT AND PRODUCTION of Gas Turbine Accessories

Holley started to design and build aircraft fuel controls in 1937—the year of Lindbergh's historic flight. We've been a major supplier of fuel controlling devices ever since—right through today's jet age. Aircraft gas turbine control devices are Holley Aircraft's business ... and we know our business well. Hands that are skilled in research—design—development—and precision manufacture of gas turbine components should be yours. Try them—see how they will help!

**HOLLEY**  
Aircraft

Call or write for further information,  
and your copy of Holley Aircraft's  
Factbook Book.

A-11-4

Division of  
**HOLLEY CARBURETOR CO.**  
11555 E. Nine Mile Road, Dept. A, Warren, Michigan

divides that spends \$2.5 million annually buying up its inventory for resale to local home operators and others. Southwest Airplane has a total facility whose replacement value is estimated by management to be in the neighborhood of \$1 million. In addition, it is developing a facility at Menasha Field in Ft. Worth which will require an investment of more than \$150,000 in hangars, fuel tank farms, fuel trucks and aircraft servicing equipment over the next year.

That the company is a large purveyor of many products and supplies is evident in reviewing data on recent operations on the first six months of 1962: it took care of approximately 15,500 airplanes, sold nearly 10,000 per gallon, about 2.1 million gal. of fuel at Rose Field. Last year, the service fuel meter it spent approximately \$100,000 on shop supplies, such as chemicals and solvents, light-duty shop equipment and the like for dry-dock operations, about \$25,000 for office supplies, more \$50,000 on building maintenance supplies and more than \$100,000 on repairs.

Franchised distributors and dealers, which are the backbone of the worldwide flying operation, do its normal volume of business more than half of its business sales. This distribution and dealers at Bush Aircraft Co. also have done good general business including sales of new and used airplanes, parts, service, fuel and financing—approximately equal to the entire business plane manufacturing industry's sales of new airplanes.

Like other manufacturers, Beech is working some dealers to add to its inventory with the realization that they can find a share in the industry's sales volume of some \$900 million annually in aircraft accessories and services. Like the independent operators, these outlets provide steady outlets for new products, servicing, equipment, parts, buildings and supplies necessary to conduct their business.

Sales and service business must also be large volume, according to an FAA survey. Approximately 15,000 engine overhaul are done on general aviation aircraft in the U.S. each year, and it is estimated that a retrofit market for engine components alone in this market currently exceeds \$60 million.

Manufacturers are a primary outlet for supplies and services. Cessna, with a line of 16 different models planned in the near future, which it expects to be the best in its business, is planning a production plant expansion program costing more than \$2 million to build in metropolitan Kansas City.

Last year this company spent more \$25 million with vendors and suppliers for such things as engines, pistons, valves, radio, upholstery materials, sheet metal plastics and associated hardware for its business plane line.

## NEW AEROSPACE PRODUCTS

### Miniaturized 3-Way Solenoid Valve

High pressure, long, unactuated solenoid valve is designed for hydraulic systems requiring high speed control of actuators and as a remote check-and-divert for pressure remedies and backflow of pressures up to 5,000 psi.



Device has operating times in the five microsecond range, instant compactness and has all parts in a single piece.

Order size ranges from .010 to .013 in. The valve is made with 1/8 and 1/4 in. tubing connections as standard.

Physics Controls, Inc., 1701 Elizabeth Ave., Linden, N. J.

### Precision Glimometer

Precise diameter made angles in five seconds of arc, and by extension to one second.

The instrument, Model TR-96, permits reading over a 360 deg. range. The fundamental scale is indicated by a program level, orientation is read directly from a high-contrast, circular glass scale through the reading microscope.



The glass scale, divided from 0 to 360 deg., at 20-min. intervals and graduated every degree, rotates with the target level about a horizontal axis. Subdivisions of the 10-min graduations are made by an optical system, the scale of which is fixed at 5-min. intervals.

vals. Exposure is selected in a 41 deg. angle, and can be reset in position for most convenient reading.

Applications include aerial guidance, test stands and control equipment, radar antennas and angular wheel or related machine tools.

Engel Equipment Co., Div. of Engineering and Scientific Instrumentation, 631 S. Dearborn St., Chicago 3, Ill.

### High Vacuum Manipulator

Manipulator, MTC V8-120, is designed for grip. Left hand is move in vacuum in the 18" radius.

Device is made of stainless steel and aluminum and sealed with Viton O rings on a ball joint. Movement is work in a 60 deg. cone. Double in control is, below lock clock and 100% response the manufacturer says.

MRC Manufacturing Corp., Orangeburg, N. Y.

### Rocket Test System

Portable rocket engine test stand equipped with a small rocket engine and associated controls and instrumentation is designed for use in a research tool in materials, propellant or plasma studies or as an advanced training aid.



Called Labroc Model V, the system provides the characteristics of current liquid propellant rocket test engines in terms of pressure, efficiency, thrust, temperature. Records, warms and reads temperature. Console displays a continuous monitoring of thrust, combustion chamber pressure, fuel flow, oxidizer flow, coolant flow, motor head pressure. Fuel feed pressure, coolant in let and outlet temperatures. Rocket engine is a water-cooled bipropellant gas jet producing up to five of thrust.

Special rocket making experience or an auxiliary water propellant stream, handling and utility devices have been built into the system, the model test unit.

Advanced Technology, 1275 Bloomfield Ave., Caldwell Township, N. J.



these  
skilled  
hands  
can be  
yours..

#### for PRODUCTION OF Your Own Precision Parts

Look close up at the fuel control on one of today's jet aircraft engines. Intricate? Complicated? That's true, and you'll appreciate that it takes "skilled hands" to build them. Holley Aircraft has these hands ... the performance, proven and available you for precision manufacture of your own designs.

Call or write today for  
factbook  
information,  
or its average  
meeting  
A-11-4

**HOLLEY**  
Aircraft

Division of  
**HOLLEY CARBURETOR CO.**  
11555 E. Nine Mile Road, Dept. A, Warren, Michigan



Need a synchro?



Send for one of these



or one of these.

One of the advantages you'll find in coming to us for Autogaps® synchros is the personal touch. Our sales engineers work very closely with our customers.

Another advantage, of course, is the complete line that we offer. We maintain one of the most complete inventories of different types of synchros. Some of the parts have measurements as close as 56 millionths of an inch. All parts are ultrasonically cleaned before assembly.

We are currently working on units that will operate

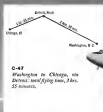
efficiently in temperatures as high as 1000°F. And we are supplying synchros that are resistant to nuclear radiation and are capable of efficient operation at 500°F.

Our test and assembly facilities have been expanded to an area covering 14,000 square feet. New equipment is permitting production of parts accurate enough for use in space and missile applications. Be you sure, there's nothing we can't handle in the way of synchros. Call us in South Plainfield, N.J., Phone MAJOR 270, TWX 298.

Montrose Division



Circle Number 66 on Reader Service Card



GREAT OLD WORKHORSE



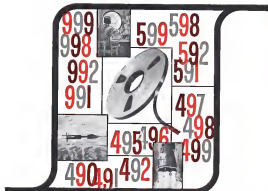
GREAT NEW WORKHORSE

The turboprop Gulfstream—available now without major modification for high-priority personnel (24), cargo, airways checking, navigational training. Cruising speed: 350 mph to 30,000 feet altitude. Range: transcontinental. Payload: 10,000 lbs. Lands, takes off from virtually any military airfield. Not a "stopgap" airplane. The Gulfstream has been designed to fit long-range logistics planning for the next 20 years. Utility, performance, low operating costs. That's why nearly 90 Gulfstreams are now in operation with worldwide corporations and the Federal Aviation Agency.



**GRUMMAN**

AIRCRAFT ENGINEERING CORPORATION  
Bedpage • Long Island • New York



## World's widest tape selection offers heavy-duty constructions for every instrumentation need!

Today's stepped up pace for data recording with the electronic instrumentation tapes that stay cool despite ever-increasing transport speeds, greater tensions, and both fast build-up of recording heads. And the "Scotch" brand Instrumentation Tape line, with a tape for every instrumentation requirement, now includes 16 heavy-duty constructions that support difficult operating environments.

"Scotch" Heavy Duty Instrumentation Tapes are made with a special high-purity grade and binder formulation that minimizes run-off, withstands temperature from -60°F to 250°F (40°F to 150°C) tests prove these tapes last a minimum of 10 times longer than ordinary tapes—capture signal with constant fidelity through high pressures and speeds.

The inside coating affords nearly 1000 times greater productivity than conventional tapes—draws off dust-minimizing static charges to ensure clear tape path, ensuring accurate data. And exclusive Siluxone lubrication protects against head wear, tape-to-tape tape life! These tapes

series of heavy duty tapes are available in a variety of widths and lengths.

"500" series heavy duty films feature exceptionally long life, excellent high and low frequency modulation, 3 construction—18 mil, 43 mil and end-coatings on 43, 1, 3.3 and polyester backings, 34 mil end-coatings on 1 and 1.5 mil backings.

"500" series heavy duty films combine long wear, controlling uncoils to remove heavy residues of extremely high frequencies, 4 constructions—1 or 3.3 mil polyester backings, 18 or 43 mil end-coatings.

"500" series heavy duty films, designed especially for 160000 CM-100 series Recordar Reproducers, provide ultra-extended recording solutions for critical short wave length requirements, 4 constructions—1 or 1.5 mil polyester backings, 18 or 43 mil end-coatings.

Whichever your tape requirements—standard, high speed, high modulation, standard or heavy duty—there's a right "Scotch" Instrumentation Tape. Call your nearest 3M representative for helpful technical details. Or write Magnetic Products Division, Dept. MCA-122, 3M Company, St. Paul 3, Minn.

3M COMPANY  
MAGNETIC PRODUCTS DIVISION  
DEPT. MCA-122, 3M COMPANY, ST. PAUL 3, MINN.  
5000 3M DRIVE, ST. PAUL 3, MINN. 55105

Magnetic Products Division 3M



## BUYERS GUIDE SECTION

### PRODUCTS AND SERVICES

page 90

### INDEX OF PRODUCTS AND SERVICES

page 235

### MANUFACTURERS INDEX

page 247

### READER SERVICE

page 257

### DISTRIBUTORS INDEX

page 261

### U.S. AIR CARRIERS AND FREIGHT FORWARDERS

page 263

### INDEX OF PRODUCTS ADVERTISED

page 265

### FEDERAL AVIATION AGENCY CERTIFICATED REPAIR STATIONS

page 267

### SEARCHLIGHT: Products and Services Index

page 285

### ADVERTISERS INDEX

page 292

More than 2,000 aerospace products and services are listed alphabetically. Aerospace companies in the U.S., Canada, United Kingdom and Western Europe are represented. This listing spans 95 full pages and is the aerospace industry's most comprehensive source of product information and suppliers. Research and development organizations are included as well as manufacturers, test and service companies and suppliers of basic materials. Names of BUYERS GUIDE ISSUE advertisers appear in boldface capital letters, followed by the page numbers for their advertisements.

Alphabetical listing gives the names and page numbers of all products and services contained in the PRODUCTS AND SERVICES section.

Names and addresses of all organizations represented in the PRODUCTS AND SERVICES section are listed alphabetically in the MANUFACTURERS INDEX. Names of BUYERS GUIDE ISSUE advertisers appear in boldface capital letters, followed by the page numbers for their advertisements.

Additional free information about products and services advertised can be obtained by using the Reader Service postcards contained in this BUYERS GUIDE ISSUE. Each advertisement has a Reader Service number. Circle this number on the postcard, fill out the card and mail it.

Names and addresses of aerospace distributors are listed alphabetically. Names of distributors advertising in the BUYERS GUIDE ISSUE appear in boldface capital letters, followed by the page numbers for their advertisements.

Complete names and addresses of certificated air carriers, supplemental air carriers and air freight forwarders—international and international—are listed.

Alphabetical product listing provides quick reference to the product information contained in advertisements appearing in the BUYERS GUIDE ISSUE.

Aviation repair stations in the U.S. and overseas which are certificated by FAA are listed by region. Names and addresses of repair stations are followed by code numbers which show the type of repair services performed.

Products and services offered by SEARCHLIGHT advertisers in the BUYERS GUIDE ISSUE are listed.

Alphabetical listing of all BUYERS GUIDE ISSUE advertisers.

NAVIGATOR'S ASTROLABE, 1466, by which time east longitude are definable; changed, since its invention in 150 BC, as the world's oldest scientific instrument. This is one of a series commissioned by the Canadian Marconi Company. A printed reproduction of this historic navigating instrument, size 11 x 14 inches, is readily available on request.



Circle Number 19 on Reader Service Card



## 2113 years before DOPPLER

Between the astrolabe and Doppler is 2113 years of man's attempt to mark an accurate track of his coming and going over the earth, and of his immediate position on its surface. Canadian Marconi Doppler provides a new measure to the navigator's art provided by the astrolabe for latitude, compass for direction, sextant for position and chronometer for time. With the compass, CMD Doppler gives the art of these elements, without human error, in the most accurate and reliable system used today. CMD designs and manufactures Doppler for "T" and "Z" bands, Lat/Long and Along and Cross Track Computers, as well as indicators. CMD Doppler is applied to commercial transport, aerial survey, military transport, anti-airborne warfare, helicopters, V/STOL aircraft and supersonic aircraft.



Doppler Lat/Long Computer Controller

# Sinclair TURBO-S OILS



## SPACE-AGE OILS DEVELOPED FROM SINCLAIR RESEARCH

- Used in commercial jet-liners for reliability
- Used in military jets and missiles for reliability
- Used in space exploration rockets for reliability

There is no better proof of reliability—YOU CAN RELY ON TURBO-S OILS

**Sinclair** AIRCRAFT OILS 

SINCLAIR REFINING COMPANY • 600 FIFTH AVENUE • NEW YORK 20, N. Y.

Circle Number 108 on Reader Service Card



## 10,000 ACRES OF HELL

...for continuous environmental testing of Caterpillar-developed military vehicles, their components, and the full range of Caterpillar diesel electric power plants

A rugged complex of steep hills, sand flats, thick woods and rocky bluffs, the two Caterpillar proving grounds provide a wide range of terrain and climate conditions ... 10,000 acres of mud, dust, snow and ice ... desert and sub-zero temperatures

Located near Phoenix, Arizona, and Peoria, Illinois, the sites are in constant use by Caterpillar's 120-man Research Department. Once a basic design has been approved and a prototype developed, equipment is subjected to a series of rigorous tests. Through modern instrumentation, performance data is quickly obtained and evaluated

Mobile instrument laboratories, like this dynamic measurements van, allow Caterpillar researchers to probe deep into the heart and liver of machines



in actual field operation. The van's crew is pulling Caterpillar's mobile, rubber-tired engine GDEM through a strenuous test, simultaneously measuring 36 different operational characteristics

In addition to the comprehensive proving grounds facilities, Caterpillar maintains an extensive field testing and research operation wherever Caterpillar equipment is used—from baking deserts to arctic ice shelves. These experienced specialists work with other Caterpillar engineers and manufacturing people in every stage of equipment development—from basic concept to final manufacturing. It's all part of Caterpillar's continuing program for the development of new concepts in military vehicles, their components, and power packages

For more information, write Defense Products Department, Caterpillar Tractor Co., Peoria, Illinois

## CATERPILLAR

Subsidiary and affiliated divisions of Caterpillar Tractor Co.

Caterpillar Tractor Co., General Offices, Peoria, Illinois • Caterpillar America Co., Peoria, Illinois • Caterpillar Overseas S.A., Berlin • Caterpillar of Australia Pty. Ltd., Melbourne • Caterpillar (India) Ltd., New Delhi • Caterpillar Tractor Co. Ltd., Shanghai • Caterpillar of Europe Ltd., London • Caterpillar France S.A., Grenoble

Circle Number 107 on Reader Service Card



## For 10 years, Computer Control Company has designed, developed and delivered a broad range of specialized digital systems



**DOPPLER SIGNAL DATA PROCESSORS** are high speed general purpose computers designed for advanced scientific and engineering applications. A strong command structure makes the DOP 29 faster than comparable mainframe computers. Memory cycle time 5 microseconds. A single add operation takes 10 nanoseconds. Features include program distributed data transfer, multifunctional interface with character and word buffer, parallel transfer, asynchronous full interrupt.



**REAL TIME COORDINATE CONVERSION COMPUTER** continuously performs two eighty-five foot parabolic antennas used to track orbiting satellites and space probe vehicles from a West Coast site. The antennas, computer, and a microwave data link form the closed loop tracking system. Computer Control has also developed a Coordinate Conversion Computer now in use as part of an airborne telescope tracking system designed to photograph missiles during re-entry.



**BUILT LINE TIME CONVERSION SYSTEM** equipment are in tactical use aboard submarines, permitting extension of tactical detection capabilities. DELTIC circuits digitize input signals and hold them in active storage, priority sequencing them in time for real time signal conversion. 3C DELTIC equipment provides significant reduction in the complexity and size of signal processing equipment for application to sonar, radar, telemetry and audio spectrum analysis.



**SPACE DATA AUTOMATION SYSTEMS** are solid state systems designed to make possible receipt of technical data from unmanned spacecraft scientific experiments, and to act on selected sequences sent to the spacecraft. The 3C/SDAS allows unmanned spacecraft to vary their command sequences by internally generated sequences of events, external signals, sensed by experiments, or by radio commands. SDAS systems operate on less than 1 watt of power.



**DIGITAL CONTROL COMPUTER AND LOGIC TRAINERS** are employed in teaching team classes the fundamentals of digital computer construction, programming and operation. These units consist of a general purpose computer for a specific logic demonstration with removal of the front panels. The trainer permits an entire class to follow each instruction step by step through the machine. When used as a logic demonstrator, various types of logic modules with large MIL standard symbols are plugged into the front panel for logic interpretation by the instructor or students. Computer Control Company has developed a variety of digital logic systems for industry and the military.

### CC DIGITAL SYSTEMS ACTIVITIES

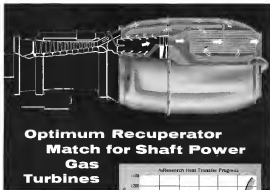
- ☐ Missile tracking and radio astronomy positioning
- ☐ Industrial process and machine tool control
- ☐ Data monitoring
- ☐ High-speed stored program scientific computers
- ☐ Real-time business data processing
- ☐ Data compression for signal processing
- ☐ Digital logic and computer training devices
- ☐ Computer language translation
- ☐ Information storage and retrieval
- ☐ Pulse pattern and range time code generation
- ☐ Digital positioning systems
- ☐ Complex test and simulation
- ☐ Space vehicle instrumentation and simulation

For more information or to immediately visit for digital systems, contact Computer Control Company, 10000 North 10th Street, Suite 100, Seattle, WA 98107. Phone: (206) 325-1000. Telex: 100000. Cable: 100000.



**COMPUTER CONTROL COMPANY, INC.**

10000 NORTH 10TH STREET, SUITE 100, SEATTLE, WA 98107



## Optimum Recuperator Match for Shaft Power Gas Turbines

Garrett-AiResearch recuperators improve specific fuel consumption up to 40%, with minimum size and weight ratios and highest reliability

To be competitive, new military and industrial gas turbines will require optimum recuperator design and fabrication. Garrett-AiResearch experience in specialized heat transfer systems includes:

### PRODUCTION

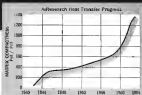
More than 60,000 heat transfer systems fabricated

### ENVIRONMENT

Thermal stress: 1000°F differential across unit  
Vibration testing: 5 to 250 cps, 150 Gs  
Temperature range: -450 to 1200°F  
Heat transfer fluids: liquid metals, air, fuel, oil, gas, cryogenic fluids

### RELIABILITY

AiResearch fluid boundary recuperators have no



moving parts, require minimum maintenance. More than 700,000 hours already accumulated in production heat recovery units.

Garrett-AiResearch uses that experience as a recuperator optimization computer program to: (1) model all heat transfer parameters to engine manufacturers' requirements, (2) interpret parametric analysis, (3) select optimum design and material, and (4) fabricate reliable equipment.

Garrett-AiResearch is working on recuperator optimization programs with more than half the military and industrial gas turbine manufacturers in North America, and is fabricating and testing complete units. For further recuperator information, write to the AiResearch Manufacturing Division, Los Angeles.

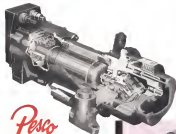


AIResearch MANUFACTURING DIVISIONS • Los Angeles, California • Phoenix, Arizona

Systems and Components for:

Aircraft, Marine, Spacecraft, Electronic, Military and Industrial Applications

Circle Number 122 on Reader Service Card



## Pesco INTEGRATED HYDRAULIC POWER SUPPLIES

PRESSURES TO 5000 PSI  
FLOW RATES TO 50 GPM

As a single source manufacturer of both pumps and drives, Pesco has a unique capability to custom engineer hydraulic power supplies. Requirements of size, weight, configuration, power input and power output can be met by matching Pesco electric or hydraulic motors with Pesco fixed displacement gear pumps or variable displacement piston pumps. Pesco hydraulic power supplies are now specified for major aircraft and missile programs — proof of Pesco's capabilities to design, build, test, and deliver power supplies demanding high performance and reliability.

Request brochure  
and data sheets from



PESCO PRODUCTS DIVISION  
2070 WENNER SUPERHIGHWAY  
21102 North Main Road • Tualatin, Ore.

Circle Number 123 on Reader Service Card

Export Sales: 2001 Warner International Corporation

26 S. Main Street, New York, N.Y. 10014

## hydraulic power

CUSTOM DESIGNED  
FOR AIRCRAFT, MISSILE,  
AND GROUND SUPPORT  
EQUIPMENT

### PISTON PUMPS

Fixed or variable displacement.  
High speed pumps with high power output and uniform flow rates with 91% volumetric efficiency and 92% overall efficiency.  
pressures to 4000 psi  
flows to 10 GPM  
up temp range -50°F to +200°F

### GEAR PUMPS

Fixed displacement.  
Patented pressure-loading design delivers high output and uniform flow rates with 91% volumetric efficiency and 92% overall efficiency.  
pressures to 5000 psi  
flows to 10 GPM  
up temp range -50°F to +200°F

### DC ELECTRIC MOTORS

Available in series basic frame sizes from 1.75 to 1.50 inches in diameter.  
Max. hp: 20,000 (continuous)  
voltage 6-110v  
resistance .005 to 100  
amp load .017 to 2150  
type open enclosed, air-cooled or water-cooled

### AC ELECTRIC MOTORS

Available in series basic frame sizes from 2.25 to 1.50 inches in diameter.  
Max. hp: 20,000 (continuous)  
voltage 115v, 208v or 480v  
type open enclosed, air-cooled or water-cooled  
phase 1 or 3  
amp load .017 to 2150  
type open enclosed, air-cooled or water-cooled

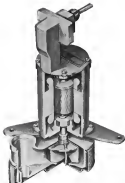
Hydraulic motors and turbine drives are also available as drives for Pesco power supplies



### PESCO DESIGNED HYDRAULIC POWER SYSTEMS

Pesco builds complete hydraulic power systems for aircraft and missiles which include PESCO pumps and motors, reservoirs, fluid line assemblies, filters, check valves, pressure switches, temperature sensing elements, relief valves, solenoids, directionals and fittings.

Circle Number 123 on Reader Service Card



## FEWER PARTS, GREATER RELIABILITY

*With Lear Siegler Centrifugal Pumps*

With only four moving parts—impeller, rotor and frictionless bearings—Lear Siegler Power Equipment Division centrifugal pumps are slow-to-wear and—no service-free—maintain constant efficiency. AC motor driven pumps have runtimes up to 2400 hours of trouble-free service life. Motors on submerged centrifugal pumps can be cooled by liquid flowing through the stator. This eliminates stalling, increases reliability and safety.

Lear Siegler centrifugal pumps in any precision application. Fuel booster pumps for missiles, aircraft and helicopters, centrifugal pumps for electronic vehicles and specialized industrial and commercial uses. They have standard or custom-designed mountings, wet or dry AC and DC motors, flow regulated or integral pulsar motor flow discharge ports to fit standard or special fittings. They pump any non-corrosive liquid.

We can design the centrifugal pump for your application, ground support or industrial application. Tell us the basic parameters of your application. Or, if you desire technical data on one of our present line of pumps, ask for our data file.



DC Motor Driven Centrifugal Pumps with flow from 120 gpm to 3000 gpm; weight from 5 pounds to 12 pounds.

AC Motor Driven Centrifugal Pumps with flow from 100 gpm to 10,000 gpm; weight from 3 pounds to 12 pounds.



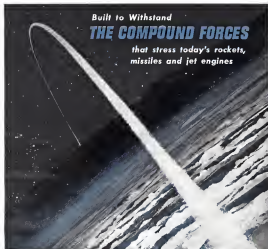
LEAR SIEGLER, INC.

POWER EQUIPMENT DIVISION

Formerly Lear Power Division

311 SOUTH ARIZONA ROAD, TAYLOR, MISS.

Circle Number 124 on Reader-Service Card



Built to Withstand  
**THE COMPOUND FORCES**  
that stress today's rockets,  
missiles and jet engines

## ROLLWAY Precision Radial Roller Bearings —designed for the space age

Acceleration and deceleration shock! Multiple G forces, both radial and axial! Five thousand vibrations in the extreme! Each makes new demands on design and materials. All require advanced concepts in the alloying, rolling, forging, grinding, dimensioning and stress relief of high-temperature, high-tolerance bearing steel.

Already operational in out-front aeronautical

applications, new and more sophisticated Rollway Precision Radials are on the boards or undergoing R&D for top aircraft products.

For a quick view of dynamic capabilities, load ratings, bearing speeds, etc., ask for Precision Radial Catalog No. AR150. For a glimpse into potentials, let our R&D men discuss the possibilities with you. Rollway Bearing Company, Systems, N. E.



QUANTITIES 1000 OF RADIAL AND THRU-BORE CHAIN ROLLER BEARINGS

**ROLLWAY®**

HEADQUARTERS: CHICAGO, ILL. • BRANCHES: ALBUQUERQUE • BOSTON • CHICAGO • DALLAS • DENVER • DETROIT • LOS ANGELES • MIAMI • MINNEAPOLIS • NEW YORK • PHILADELPHIA • PITTSBURGH • RICHMOND • ST. LOUIS • ST. PETERSBURG • TAMPA • WASHINGTON, D.C.

Circle Number 125 on Reader-Service Card

# AMP

## PUTS AN END TO EVERY CIRCUIT PROBLEM

A patented Compression Crimp Technique—the finest research and testing techniques in the industry...an exclusive plating process...a sales and service organization that spans the world...all these are factors contributing to AMP's reputation as the undisputed leader in the field of Boltless Wire Termination. Shown here is a representative sampling of the more than 15,000

electrical/electronics products we design and manufacture. All are designed to provide you with more reliable circuitry. All are available for immediate delivery. From basic ring terminal terminals to intricate programming systems...from one crimp contact connectors to compression crimp line wire splices...whenever a circuit needs completion, AMP delivers the best, fastest and most economical answer.

### COAXIAL CABLE AND SHIELDED WIRE PRODUCTS

**COAXIAL™ CONNECTORS**—Quick connect/disconnect for coaxial wire with one crimp termination of inner conductor, outer braid and outer shield...an exclusive AMP® braze; multiple and single line types; in standard, miniature and subminiature models. RG/U sizes D75 to 250. Gold over nickel contact plating...standard with AMP.



**MINIATURE™ (Type 1) CONNECTOR**  
—12 and 30 position



**STANDARD™ CONNECTOR**—18, 24 and 34 positions. 36 and 48 positions also available on request.



**COAXIAL™ CONNECTOR**  
—Pin and Socket type

**TERMINALIZED™ SPLICES AND TERMINALS**—with pre and post insulated for single and multiple conductors with nylon or Teflon® insulation. Wire conductors: shielded, non-shielded braided and a new pre-insulated Service for printed circuit boards.



**TNC™**—Standard and miniature sizes. Full hardware variety of connectors for through panel installations.

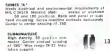
**ENC™**—Exposed contact end useful for a wide conductivity range of dielectric substrates. Mounts from thickness of .001 to .010". Mounts from .001 to .010".



### PIN AND SOCKET MULTIPLE CONNECTORS

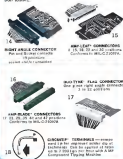
AMP's versatile Pin and Socket connectors satisfy and exceed applicable Military and commercial requirements. Complete range of sizes and configurations. Features crimp, single or double. Available in standard and bonded and wire machine processed types. In single point or strip form for connection with AMP® lead, semi-automatic or fully automatic crimping tools. Gold over nickel contact plating...standard with AMP.

#### Connectors conforming to MIL-C-8834



### PRINTED CIRCUIT CONNECTORS

AMP's versatile one and two piece printed circuit connectors, available in a wide variety of sizes and configurations. Unique crimp, single or double. Features crimp, single or double. Available in standard and bonded and wire machine processed types. In single point or strip form for connection with AMP® lead, semi-automatic or fully automatic crimping tools. Gold over nickel contact plating...standard with AMP. Complete range of lead, semi-automatic and fully automatic application tools.



### TAPER TECHNIQUE

Miniature components for high density applications. With pre and post insulated, standard and bonded and wire machine processed types. Available in a variety of sizes and configurations. Features crimp, single or double. Available in standard and bonded and wire machine processed types. In single point or strip form for connection with AMP® lead, semi-automatic or fully automatic crimping tools. Gold over nickel contact plating...standard with AMP.







A close-up photograph of a cable joint or connector, showing a metal fitting and a cable end.



Some Aircraft Type Defect Alerts for 2000 in 2000 and operating premiums as accordance with NTSB 2000-10-001. (Continued)

<sup>10</sup> *Journal of Law and Economics* 2003, 46:103–124.

**AEROSPACE CORPORATION • AIRCRAFT Division • JETENGINE Division**  
**JACKSON PLANT JACKSON MISS • WITTEN PLANT BIRMINGHAM ALAB • JESSUP PLANT JESSUP MARY • BELL PLANT CHANDLER TEX**  
**AEROSPACE CORPORATION • MARINE Division • LOS ANGELES CALIFORNIA**  
**AEROSPACE CORPORATION • MARINE Division • BIRMINGHAM ALABAMA**  
 In Canada: Aerodyne (Canada) Ltd. Toronto Ont. • In Germany: Aerodyne GmbH, Wuppertal North-Rhine  
 AERODYNE INDUSTRIES INC. PORTLAND ME. BIRMINGHAM ALA. CHANDLER TEX. AND JESSUP



**What other metal  
could they have used!**

**... what other experienced fabricator but  
MAGNESIUM AEROSPACE PRODUCTS**

"Telstar", requiring the best choice of materials for a strength-weight ratio, made use of magnesium alloy fabricated frames, frame sections and stabilizing castings to produce only 31 pounds of end components. These structural frames and antennas met the very exacting requirements of the communications satellite and became only a fraction of the total weight.

MAGNESIUM AEROSPACE PRODUCTS, pioneers in the development and application of magnesium fabrication, was the group selected to do the job. This decision was based on the following qualifications... three decades of magnesium fabrication, specially trained and skilled magnesium, personnel, equipment and processes. Government certified, and security cleared. These qualifications, along with 50,000 sq. ft. of modern manufacturing area, prototype or production facilities, job or custom operations, and reliability, quality and service highlighting every job, made MAGNESIUM AEROSPACE PRODUCTS the logical manufacturer.

"Telstar" components represent only one of the many important accomplishments of MAGNESIUM AEROSPACE PRODUCTS. MAP is equipped to meet any magnesium or aluminum fabrication requirement. Write today for additional information.



Thomas E. McManis  
A. J. Perry, Jr.  
Box 400, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

Circle Number 155 on Reader Service Card

# SPHERCO

**SPHERICAL  
BEARINGS & ROD ENDS**

**"PRECISION BUILT  
FOR SUPERIOR  
PERFORMANCE"**



## FEATURING...

- Quality engineered and produced
- Solid inserts
- Sintered shims of 3-piece rod end
- Wide range of materials for races



**WRITE FOR BULLETIN 549**



A. H. HART OF  
MAGNETIC BEARING DIVISION  
LITTON - A JACOBY MFG. CO.  
24 BURGWAY AVE. - ANDER, RA.  
Circle Number 156 on Reader Service Card



**A  
FILTER  
THAT  
DOES  
SOMETHING**

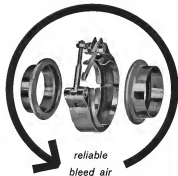
## CREATES A NEW SOURCE FOR AEROSPACE FILTERS ... UNCOMMITTED TO EXISTING TECHNIQUES

Extensive design and manufacturing experience with the accuracies demanded in aerospace fluid handling enables Hydrodyne to put its reputation for excellence on the line... a line of fluid filters for every air and space application.

This new line of high application filters is built with the same rugged quality and precision performance as Hydrodyne's well-known bellows type Static Spring Seals... with new ideas and techniques. If it's an aerospace filter, call HYDRODYNE!



Circle Number 157 on Reader Service Card



## duct couplings

If your concern includes the reliability of pneumatic duct couplings in aerospace applications, take a look at the Janitrol line. Janitrol bleed air couplings have industry-wide acceptance because they provide virtually 100% sealing with low nut torques, lower stresses mean higher reliability. Absolutely no gaskets are required. For the ultimate in safety specify Duct-Lock® couplings that seal even if the bolt is disconnected. Janitrol clamps, flanges, duct supports and other hardware are used in the 707, 880, 990, DC-8, F-105D, F4H, F-110, F3U and other high performance aircraft.

Janitrol standard and Duct-Lock couplings are described in our 56 page catalog, a valuable reference for designers.

Janitrol also designs and builds couplings for special applications—extreme high temperature and pressure, and cryogenics. Request catalog JA 342 from Janitrol Aero Division of Midland-Ross Corporation, 4200 Surface Road, Columbus 4, Ohio.

**JANITROL AERO**

A division of Midland-Ross Corporation  
Circle Number 134 on Reader-Service Card

## ONLY MAGNETIC PERT CHART KIT ON THE MARKET TODAY



**ESSE—  
QUICK—  
SIMPLE TO CONTROL**

**Only \$19.95**

- Board made of lightweight Inconel inserted with magnetic compound that will attract a magnet, and provide ideal drawing surface. Eliminates old-fashioned magnetic steel panels. Will not oxidize.
- All specially made rubber and magnets are magnetic and color coded.
- Easy to remove a maximum of 30 sets, actual magnetic strength 40 ft. of wire without magnets. Offers a water-soluble marking pencil and PERT Chart magnet.
- Board and accessories can be used over and over again.
- Dual background optional for graphs, charts, and statistical procedures.
- Three standard board sizes available—also custom made in any size on possible, standard or other background material required.

### FOR INDUSTRY



- Ideal for placement in portable expansion chart.
- Provides rapid control of planning, re-planning and control.
- Perfect for sales, budgeting, estimating and inventory control.
- PROJECTS DIRECTOR CAN NOW MAINTAIN AN ACCURATE CONTROL OF THE EXPANSION OF HIS ORGANIZATION (SIC).
- IDEAL FOR USE GRAPH ON OTHER SOURCES OF PRESENTATION.
- THIS EXCLUSIVE MAGNETIC PERT CHART SET WILL SAVE TIME AND PREVENT COSTLY MISTAKES.

\*Complete PERT of PERT charts, magnets and rubber compound in additional sets.

Send for Free Literature Please—  
Or Send Your Requirements  
for Custom-Made Boards



**MAGIC  
DECORATOR  
COMPANY**

1330 North Rock Hill Road  
St. Louis 24, Missouri  
Circle Number 135 on Reader-Service Card



## NEW transistorized time delay relays

For accurate, reliable time delays under conditions of extreme temperature, vibration, shock or acceleration, check Eagle AT series transistorized time delay relays. Timing network utilizes an R-C time constant for accuracy. Quality control procedures meet MIL-PRF-50006 specifications. Small size and light weight make units ideal for airborne, mobile and portable equipment as well as for critical ground support equipment. Plug-in features permit fast, convenient servicing.

### 3 BASIC TYPES

1. Load contact closes (or opens) after a predetermined time . . . precision and reset.
2. Load contact closes (or opens) during timing interval. Automatically resets at end of preset time. Used with momentary contact to stop.
3. Load contact is "ON" and "OFF" for predetermined time continuously until voltage is removed. Write for Bulletin 550.

### Instantaneously Sealed Timers ON-OFF-ON



### Preprogramming Timers (MIL-spec)



**EAGLE SIGNAL COMPANY • Moline, Illinois**  
INDUSTRIAL DIVISION

DIVISION OF GANERWELL COMPANY, AN E. W. BLISS COMPANY SUBSIDIARY

Circle Number 136 on Reader-Service Card

...for the first time



*A Systems Concept...*

applied to the procurement of

**STEEL FORGINGS  
ACTUATOR CYLINDERS  
AUTOCLAVES  
ISOSTATIC PRESSES  
HYPERVELOCITY GUNS  
SHOCK TUBES**

...through

*Single Source Responsibility...*

**DESIGN  
MELTING  
VACUUM PROCESSING  
FORGING  
HEAT TREATING  
MACHINING  
TESTING  
INSPECTION**

for information write:

**NATIONAL FORGE COMPANY**

Division 2000 IRVING, WARREN COUNTY, PENNSYLVANIA

Circle Number 142 on Reader Service Card



Full Production of...

- ★ CALCIUM FLUORIDE doped with TRIVALENT URANIUM (amplifiers) ... sole supplier
- ★ CUPROUS—CHLORIDE, BROMIDE, IODIDE
- ★ "TRIASE" LAMPS
- ★ "SELIG" Implanetary Laser Build
- ★ "HYROGLASS" Optical grade acrylic glass
- ★ SINGLE CRYSTAL KITS
- ★ GAS LASER UNITS
- ★ SOLID STATE LASER UNITS

**Semi-Elements, Inc.**

Bechtelton Road, Bensenville, Ill. 60015  
Circle Number 144 on Reader Service Card



**IF...**

you want a better Snow motion polystyrene... use with longer useful life and higher rigidity... be sure to specify MEKTRON probe. Polystyrenes give us configurations made by Meltron have the advanced characteristics.

MEKTRON designs and fabricates to your specifications in research and development and in full quality controlled production.

Quick delivery, too and quality puts from Meltron cost less.

PO BOX 40 MISSOURI CITY MO 63051  
CIRCLE 1700, CHICAGO

**MEKTRON**  
a division of  
**CALIFORNIA GENERAL, INC.**  
8710 N. MELBOURNE BLVD  
SUNNYVALE, CALIF. 94086

Circle Number 145 on Reader Service Card

We are heavily involved in exotic instrumentation.



A case in point is cryogenics.

In addition, fully equipped cryogenic development laboratories, a unique combination of Bendix experience is available to help meet your cryogenic experimental requirements. Our experience includes 11 years—liquid hydrogen, 24 years—liquid oxygen, and 42 years—precision instrumentation.

Perhaps one of your requirements is the precise measurement of temperature between 20°K and 400°K

with digital readout. We can meet this and other cryogenic problems today.

In addition to cryogenics, we are also active in the development of life support systems (both aircraft and manned modules), propellant measurement and control, precision special purpose electronics.

Tell us what you are working on. Tell us what you need. Let us help you. Write us in Des Moines, Iowa. Dept. A.P.R.

**Pioneer-Central Division**



Circle Number 142 on Reader Service Card



## HONEYWELL SYSTEMS

### 37 OPTICAL SYSTEMS AND SELECTIVE NAVIGATION SYSTEMS

Honeywell's high-resolution color and black-and-white optical systems are used in a wide variety of applications, including head-on and side-on collision avoidance, target identification, and threat detection. The systems are designed for use in a wide variety of applications, including head-on and side-on collision avoidance, target identification, and threat detection. The systems are designed for use in a wide variety of applications, including head-on and side-on collision avoidance, target identification, and threat detection.

**38 ENGINE PRESSURE RATIO MONITORING SYSTEM** The Honeywell EPR system is designed to monitor engine pressure ratio (EPR) and provide early warning of engine failure. The system is designed to monitor engine pressure ratio (EPR) and provide early warning of engine failure. The system is designed to monitor engine pressure ratio (EPR) and provide early warning of engine failure.



**39 REACTION CONTROL SYSTEMS** Honeywell's reaction control systems (RCS) are designed to provide precise control of spacecraft attitude and position. The systems are designed to provide precise control of spacecraft attitude and position. The systems are designed to provide precise control of spacecraft attitude and position.



**40 MAGNETIC MEMORY DRUMS** The Honeywell magnetic memory drums are designed to provide high-speed, high-capacity data storage. The drums are designed to provide high-speed, high-capacity data storage. The drums are designed to provide high-speed, high-capacity data storage.

**41 FLUID AND PROPellant MANAGEMENT SYSTEMS** The Honeywell fluid and propellant management systems (FPM) are designed to provide precise control of fluid and propellant flow. The systems are designed to provide precise control of fluid and propellant flow. The systems are designed to provide precise control of fluid and propellant flow.



**42 NAVIGATION SYSTEMS** The Honeywell navigation systems (NAV) are designed to provide precise navigation and positioning. The systems are designed to provide precise navigation and positioning. The systems are designed to provide precise navigation and positioning.

**43 DATA ACQUISITION SYSTEMS** The Honeywell data acquisition systems (DAQ) are designed to provide precise data acquisition and processing. The systems are designed to provide precise data acquisition and processing. The systems are designed to provide precise data acquisition and processing.

**37 INERTIAL PLATFORMS** These inertial platforms are designed to provide precise navigation and positioning. The platforms are designed to provide precise navigation and positioning. The platforms are designed to provide precise navigation and positioning.



**38 INERTIAL CHECKOUT** This system is designed to provide precise navigation and positioning. The system is designed to provide precise navigation and positioning. The system is designed to provide precise navigation and positioning.



**39 PRECISION MAGNETIC OSCILLATORS** These oscillators are designed to provide precise frequency and timing. The oscillators are designed to provide precise frequency and timing. The oscillators are designed to provide precise frequency and timing.



**40 ATMOSPHERIC COMPOSITION SENSORS** These sensors are designed to provide precise measurement of atmospheric composition. The sensors are designed to provide precise measurement of atmospheric composition. The sensors are designed to provide precise measurement of atmospheric composition.



**41 AIR DATA COMPUTER** This computer is designed to provide precise air data processing. The computer is designed to provide precise air data processing. The computer is designed to provide precise air data processing.



**42 ADVANCED DISPLAYS** These displays are designed to provide precise visual information. The displays are designed to provide precise visual information. The displays are designed to provide precise visual information.



**43 HONEYWELL GEN-POINT INSTRUMENTS** These instruments are designed to provide precise measurement and control. The instruments are designed to provide precise measurement and control. The instruments are designed to provide precise measurement and control.



**44 HONEYWELL AIRCRAFT COMPUTER** This computer is designed to provide precise aircraft data processing. The computer is designed to provide precise aircraft data processing. The computer is designed to provide precise aircraft data processing.



**45 RAGAR ALTIMETERS** These altimeters are designed to provide precise altitude measurement. The altimeters are designed to provide precise altitude measurement. The altimeters are designed to provide precise altitude measurement.



**46 ANALOG-DIGITAL (SERVO) CONVERTERS** These converters are designed to provide precise analog-to-digital conversion. The converters are designed to provide precise analog-to-digital conversion. The converters are designed to provide precise analog-to-digital conversion.



**47 HONEYWELL DIGITAL ANALYZER** This analyzer is designed to provide precise digital data analysis. The analyzer is designed to provide precise digital data analysis. The analyzer is designed to provide precise digital data analysis.



**48 HONEYWELL TAPE READER** This reader is designed to provide precise tape data reading. The reader is designed to provide precise tape data reading. The reader is designed to provide precise tape data reading.



**49 HISTORIZED DIGITAL-ANALOG CONVERTER** This converter is designed to provide precise digital-to-analog conversion. The converter is designed to provide precise digital-to-analog conversion. The converter is designed to provide precise digital-to-analog conversion.



**BUSINESS REPLY MAIL**  
No Postage Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

**Honeywell**

MILITARY PRODUCTS GROUP, MINNEAPOLIS-HONEYWELL  
MAIL STATION #71  
2800 RIDGWAY ROAD  
MINNEAPOLIS 43, MINNESOTA

FIRST CLASS  
PERMIT NO. 33  
MINNEAPOLIS, MINN.



**STROBE 18 SEA SCANNER** features a wide-angle search of the water. The scanner is designed to provide precise water scanning. The scanner is designed to provide precise water scanning. The scanner is designed to provide precise water scanning.



The Sea Scanner can be set to scan the water in a wide area. The scanner is designed to provide precise water scanning. The scanner is designed to provide precise water scanning. The scanner is designed to provide precise water scanning.





USS ER-YEN STEEL is the lowest member of our High Strength Steel Family. It is a thirty value—offering one of the highest strength-to-weight ratios of all steels.

USS EX 709 Steel is intended to fill the need for a economical grade for applications in which greater strength, to gain weight reduction, is the primary requirement. USS EX 709 Steel has good ductility and

US8 EN-TEN Steels are sold to minimum mechanical properties shown here, and meet the following specifications:

MTL 5.10200 Class 1 Grade 1 EN TYP 45 in sheet, strip, plates, shapes, and bars  
 MTL 5.10201 Class 1 Grade 2 EN TYP 50 in sheet, strip, plates, shapes, and bars

© 2004 SASSA (SASSA) is a registered trademark of SASSA. All other trademarks are the property of their respective owners.

S&W 70-90 C.R. TUN #3 is shown, along with #2, #4, and #5.

242 950A LO-TH NO in chest and legs  
 242 950B LO-TH NO in chest, legs, pectoral shapes, and bun

THE 1980S. EX TEN 80 is a short and sharp  
and with a very strong, it is

REC'D BY: 505 (A) TON 4/10/00

<sup>10</sup> *World Atlas of Agricultural Terms in Female Institutions*.

wriethly, its resistance to atmospheric corrosion is the same as that of carbon steel. This may be doubled by specific copper, 20 maximum.

USS EN 70N Steel is suggested for such applications as automotive and truck parts, cargo containers, tank boats, fire and building materials, LP gas cylinders, construction machinery, lawnmowers and more others.

This work falls under product is made of material: *unclassified* (U)

[illegible]

AR (A.T.T.) Strengths: Phosphorus 34 mg, Sodium 32 mg.  
 A.T.T. Disorders: (specimen): minimum number of tests and quantity (indicated) is 1 weekly.  
 When not listed products are not included or recommended. The specimen is not included in the list of specimens.

#### Additional Typical Properties for Engineering Guidance

Force index in compression, $\text{N/mm}^2$	Same as Carbon Steel
Compression Yield Point, psi	Equal to Tensile Yield Point
Shearing Strength, psi	Eq. Tensile Strength
Modulus of Elasticity, psi	29,000,000 in. $\text{lb./in.}^2$
Coefficient of Expansion per Degree F (70°F to 700°F)	0.00065

### Fabricating Practices for Cold Forming

Thickness of Material	Suggested Minimum Inside Radius for Angle Irons				
	EX THN 45	EX THN 60	EX THN 90	EX THN 40	EX THN 45
Up to 2 (1/2" Incl)	1 1/2"	1 1/2"	2"	2 1/2"	2"
Over 2 (1/2" to 2 3/8" (Sheets only)	2"	2"	2 1/2"	3"	2 1/2"
Flats (1 1/2" Min.)	2"	2 1/2"	3"	3 1/2"	3"

Red Burrowing is suggested for waste handling sites and 30' below

**See following page for additional information on USS High Strength Steels**



The **USS** Family of High Strength Steels  
for lighter, stronger ground support equipment

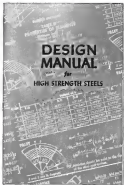


This mail will use a random sample of various threshold size

**SEND FOR ONE OF THESE BOOKS.**  
For complete information on USS High  
Strength Steels fill in the coupon below.



United States Steel



United States Steel Corporation  
Evanston 6642  
515 Williams Ferry Place  
Evanston 66, Pennsylvania

—*Shang Wenwu*

Please send me information on the sheets attached

- ☐ Design Manual for High-Strength Steels
- ☐ 505-008-TEN High-Strength Low-Alloy Steel
- ☐ 505-116-1EN High-Strength Low-Alloy Steel
- ☐ 502-5AEN-TEN High-Strength Steel
- ☐ 505-EN-TEN High-Strength Steel

Name: \_\_\_\_\_

\_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

References

Answer: \_\_\_\_\_



ENVIRONMENTAL TEST FACILITIES FOR AIR & SPACE  
TESTING

ENVIRONMENTAL TEST FACILITIES

COMMERCIAL SATELLITE TEST FACILITY

CRYOPANEL IN AIRCRAFT RESEARCH

## very high altitude ENVIRONMENTAL TEST SYSTEMS

Directly above you see OSO's, Nimble and Teitel's base for their facilities into orbital life.

- For those who need special orbiting experiments, HVEC has developed a 10+ ton vacuum to simulate 1,000,000 ft, for meeting most test requirements.
- 10" test rig systems for extreme performance testing above 400 miles.
- Thermal programs for regulated cycling from -100F to high testing temperatures.
- Automatic loading, unloading of specimens and/or test items for complete self operation every month.

**CRYOPANEL™** is the new concept in thermal environment control systems that comes closest to simulating the absolute "Mechanism" of outer space with an accuracy better than 0.50 from the visible through the far infrared range. No other thermal treatment is available that exceeds equivalent temperatures, combined with the ease of cleaning, suspension, unloading, and such low cost maintenance. You are invited to share the extensive experience of our engineering personnel. Call or write today for further information.

High vacuum facilities at Corporation is a subsidiary of Research Facilities Products Inc. more products in ultra-high vacuum equipment, facilities and a major testing, electronic job capabilities, and various advanced technical services.

**HIGH VACUUM EQUIPMENT CORPORATION**  
2 CHURCHILL ROAD • KINGSTON, MASS.  
Circle Number 188 on Reader Service Card



## LOOK TO LEACH

### RELAYABLE RELAY

Extremely Accurate, AMHS  
Approved & Subminiature Crystal  
On a Connector

### INTELLIGENT RELAY

Time Delay & Fault Sensing • 500  
MHz and Frequency • Solid  
State • Status • Self-Testing

### DATA RECORDING EQUIPMENT

All Analog Time Recorder • Accessory  
Electronics

### TELEMETRY EQUIPMENT

Command Receivers •  
Transmitters

### LEACH CORPORATION

10701 SPANISH HILLS, COMPTON, CALIFORNIA  
RELAY DIVISION, 5215 AVENUE 18, BELLINGHAM  
LOS ANGELES 3, CALIFORNIA  
CONTROLS DIVISION, 717 N. DOWNEY AVENUE  
AZUSA, CALIFORNIA  
EXPORT, LEACH INTERNATIONAL, S. A.  
Circle Number 186 on Reader Service Card

## LESS WEIGHT

PSO-Bonded  
**HERMETIC  
SEALS IN  
ALUMINUM**

electron connectors &  
other components for  
extreme space & nuclear  
environments

**PHYSICAL  
SCIENCES**  
380 North For Dale Avenue  
Pasadena, California  
A Division of Physical Data Electronics

Circle Number 187 on Reader Service Card  
Circle Number 189 on Reader Service Card



### GODDARD SERIES GAS O-RING REGULATORS

Models in bronze, stainless steel  
or aluminum  
Pilot operated type  
Max. inlet: 3000 to 10,000  
Set point range: 25,000 to 100,000 psig  
Flow to 600 acfm  
Low to gas: 10 scfm to 10,000 psig  
Pilot: 100 scfm  
Inlet: 100



### UPR SERIES BACK PRESSURE REGULATORS

Models in bronze, stainless steel  
or aluminum  
Adjustable pilot: 100 scfm  
Flow: 100-1000 psig  
Inlet: 2500-10,000 psig  
Outlet: 100



### LN SERIES LOADER REGULATORS

Models in bronze, stainless steel,  
or aluminum  
Max. inlet: 1000 to 10,000 psig  
Set point range: 25,000 to 100,000 psig  
Flow: 10 acfm  
Low to gas: 10 scfm to 10,000 psig  
Inlet: 100 scfm  
Inlet: 100



### GODDARD, BEYER, AND GODDARD SERIES GAS O-RING REGULATORS

Models in bronze, stainless steel  
or aluminum  
Compensated, high-flow type  
Max. inlet and outlet: 1000 psig  
Flow to 10,000 acfm  
Pilot: 100 scfm  
Inlet: 100 scfm  
Inlet: 100



### LV LOADER VALVE

Models in bronze, stainless steel,  
or aluminum  
Inlet and outlet: 1000 psig  
Flow: 10 acfm  
Pilot: 100 scfm  
Inlet: 100 scfm  
Inlet: 100



### GODDARD AND BEYER SERIES GAS O-RING REGULATORS

Models in bronze  
Inlet and outlet range:  
1500 to 10,000 psig  
Flow to 1000 acfm  
Pilot: 100 scfm  
Inlet: 100 scfm  
Inlet: 100

## VICTOR High pressure gas controls

Victor high pressure gas regulators are designed, assembled, tested and packaged under carefully controlled conditions to insure maximum product reliability.

Regulation shown here are typical of the available models covering a range of pressures to 30,000 psig and capacities to 90,000 scfm at -57° F to +100° F. Other types, sizes and modifications for special applications are available upon request. Write for Regulator Inquiry Form 303-B.



### VICTOR EQUIPMENT COMPANY

644 Folsom Street, San Francisco 7  
3821 Santa Fe Ave. Los Angeles 18 • 1101 E. 26th St. Chicago 19



Victor "dual" core houses maximum cleanliness in most military and nuclear facility requirements

Manufacturers of high pressure gas regulating systems & testing equipment, including the Victor Regulator, control & support systems, complete gas and steam piping, including selecting materials for reactor, boiler, turbine and others.





**precision  
fasteners  
by chandler**

CHANDLER FASTENERS ARE PRODUCED TO THE SPECIFIC REQUIREMENTS OF YOUR INDUSTRY:  
Hex Cap Screws • Hex Bolts • Special Screws and Bolts • 12 Point Bolts • Hi Tensile and Hi Shear Bolts  
Connecting Rod Bolts • AN, NAS and MS Aircraft Standard Bolts • Special Aircraft Screws and Bolts  
Plastic Self-Locking Bolts • Special Studs • Phillips Head Screws and Bolts



**chandler products corporation** • 1403 chardon road • cleveland 19, ohio

HOW TO SAVE WORK, TIME, AND MONEY

**ppd**



If you are faced with a problem of design or manufacture of small precision assemblies, you can turn to PPD... the knowledge and experience of designing and manufacturing more miniature ball bearings and ball bearing assemblies than anyone else in the world will be focused on your problem.

PPD assemblies perform reliably, quietly, and with highly predictable life. Low torque, low friction, and high speeds are no strangers to PPD's experienced engineering design team. Our manufacturing personnel are well focused — our extensive facilities specially equipped for extremely precise work. Our services are backed up by facilities for research, development and product testing.



Our customers save design work, prototyping and production time, and often the expensive, risky capital outlay for highly specialized manufacturing equipment — but mostly they save money on product. You can, too. We invite you to find out how by contacting your PPD Sales Engineer or calling our PPD Customer Service Supervisor, J. R. Howe (area code 603, 952-0310) or write for our new PPD booklet.



**ppd**

**PRECISION PRODUCTS DIVISION  
MINIATURE PRECISION BEARINGS  
INCORPORATED, KEENE, N. H.**

Circle Number 206 on Reader Service Card

**For unlimited  
sealing...**



where the "ceiling" is  
unlimited"  
on this or the  
other side of the moon...

**MINIATURE SEALS** of many sizes and configurations have been developed for O-ring seal systems to solve problems as small as the 10 to 15 mil. and critical sizes. If you're in trouble, sealing problems, use this or the other side of the moon! Call us for our service and sealing know-how. We seal any both equally well! \*Design names upon request.



**Interfering  
Gears**  
Produce precision  
bearing life  
assure light and  
under high pressure

**Minutiae  
B-Ball Bearings**

The Mini-K-Seal is particularly adaptable to compounds for dynamic and static seals in machine tool joints. (ISO) applications. Obviously small, the Mini-Seal seals dynamic joints conforming to standard applications and allows component designers great flexibility in space and weight-saving factors. Sizes range from 3/16 OD to 1-1/2 OD. Send for complete technical brochures. **FROM TO PLASTIC AND ENGINEERING CHECKS** "Casting Unlimited", a 20 minute video film, a dramatic story of the American Automobile.

**Harrison** HARRISON COMPANY  
1000 N. Main St. Portland, ME  
Area Code, 213-Phone 818-4555  
TWX 445-3587  
Circle Number 205 on Reader Service Card

"ALERT STARTS"



Photo courtesy of McDonnell Aircraft

## Sundstrand starters specified for F-110 aircraft

Aeronautical Systems Division of Wright-Patterson Air Force Base has awarded an initial procurement order to Sundstrand Aviation, a Division of Sundstrand Corporation, for Sundstrand Cartridge-Pneumatic Starters for the new McDonnell F-110 aircraft.

Sundstrand Aviation, working closely with the Air Force, developed the first fully qualified cartridge-pneumatic starter in June, 1981. Since that time, the cartridge-pneumatic starting concept has gained growing acceptance. The dual-purpose starter is ideally suited for today's multiple mission requirements if a design is to utilize conventional ground-support equipment for general operational pneumatic starts. For alert starts, or remote base operations where ground power equipment is not readily available, you use the cartridge mode.

Sundstrand Aviation is producing and delivering other cartridge-pneumatic starters under contracts with Aeronautical Systems Division for B-2H, F-100, and C-130B aircraft. The basic starter con-

figuration is readily adaptable to most military and commercial jet aircraft.

The Sundstrand Cartridge-Pneumatic Starter offers a unique combination of tested and proven advantages for military and commercial aircraft requiring self-start capabilities: safety in operation, precise and torque control, inherent overspeed limiting, reliability, dual starting capability, engine and personnel protection through positive containment, maximum environmental capability, ease of maintenance, and maximum operational life. Investigate these proven advantages today.

There are still a limited number of copies of the technical papers given at the recent Cartridge Starter Symposium sponsored by Sundstrand Aviation and conducted by Aerospace Industries Association. To get the latest information on this exciting new mode of cartridge starting, visit our response in Marketing Services, Sundstrand Aviation, Division of Sundstrand Corporation, 2801 11th Street, Rockford, Illinois.



## SUNDSTRAND AVIATION

DIVISION OF SUNDSTRAND CORPORATION, ROCKFORD, ILL.

... leader in secondary power systems

Available in Rockford, Illinois; Denver, Colorado; Oshkosh, Wisconsin; Houston, Texas; Hawthorne, California; Dayton, Ohio; Seattle, Washington; Stamford, Connecticut; Washington, D.C.



**COMPLETE FACILITIES FOR METAL FORMING**

- MU METAL
- BRASS
- INCONEL
- ALUMINUM
- COPPER
- SILVER
- NICKEL
- NIMONIC
- TITANIUM
- CARBON STEEL
- MALTITE\*
- HAYNES\* No. 25
- STAINLESS STEEL
- HASTELLOY\* X
- MAGNESIUM
- WAPALLOY

**kaupp**

**PROTOTYPE AND PRODUCTION PARTS**



## Long or Short Production Runs in Light, Medium and Heavy Gauges—



KAUPP produces commercial and military components to close tolerances. Instrument cases, covers, weldments and sub-assemblies\* in all shapes and sizes supplied to your exact specifications. 30 guest inspectors on standards assure metal components of the highest accuracy. KAUPP craftsmen are thoroughly familiar with the problems involved in fabricating today's modern metal for the most critical "space age" requirements. The KAUPP plant is equipped with the most modern fabricating machines and quality control instruments in the metal-working industry.

**KAUPP** Metal Craftsmen Since 1924

SEE SUPPLIER, SEE FOR ADDITIONAL INFORMATION



# FROM STC THE FIRST...



## PNP

# SILICON POWER TRANSISTORS



For Technical Data and prices, contact:

**SILICON TRANSISTOR CORPORATION**  
CABLE PLACE, LONG ISLAND, NEW YORK Phone 2 4102

**Various Different PNP Types:**  
11/167 her .05 watts . . . STC5000 through STC5005  
Square package . . . 65 watts . . . 2F369 2F305A, 2F424, 2F424A  
TO-18 . . . 75 watts . . . STC5008 through STC5009  
Characteristics:  $I_{C10}$  to 50 in 2 amps . . .  $I_{C10}$  65 S.S. share  
at 2 amps . . .  $V_{CE}$  65 volts . . .  $I_{C10}$  65 S.S. share  
**PNP Complements:**  
11/167 her 65 watts . . . STC1500 through STC1508  
Square package 65 watts . . . 2N389, 2N389A, 2N424, 2N424A  
TO-18 75 watts . . . STC1500 through STC1508

Circle Number 312 on Reader Service Card

**VEHICLE • PERSONNEL • CARGO • DECELERATION • TROOP • WEATHER  
RECOVERY • PARACHUTE COMPONENTS  
AIR/SEA SURVIVAL EQUIPMENT • LIFE RAFTS  
TIEDOWN DEVICES • INFLATABLE VESTS**

**PARACHUTE PRODUCTION**  
ESTABLISHED 1964  
**M. STEINTHAL & CO.**  
**ADVANCED ENGINEERING**

NEW YORK OFFICE  
333 East 42nd St., New York 17, N.Y.  
(212) 4-4100  
Circle Number 320 on Reader Service Card

### First choice of the rocket and missile industry...

These superior MARSH products are widely used and approved by the aircraft and missile industry.

#### MARSH pressure Gauges...

Because they combine the most advanced features ever found in pressure gauges and compound gauges, these are MARSH Gauges for many possible applications.

#### MARSH needle and needleless Valves...

Because they are constructed to give an immediate response to their operating pressure ranges—up to 10,000 psi for needle valves, both lines are complete and precise.

#### MARSH Gas Thermometers...

Because they offer the accurate, precise, reliable demands, these vapor pressure and thermal lines are available in wide temperature ranges and have precision and beauty.

All MARSH products available with ACP finish.



**MARSH** Write for Free  
Catalog and  
Literature

**MARSH INSTRUMENT COMPANY** Division of Columbia Oil and Gas Corporation Dept. 30—3000  
South Broadway & 10th St., Columbia, Mo. 65201 (314) 431-1000 • Telex 480000 • Cable 480000  
Branches: New York, N.Y. • Boston, Mass. • Chicago, Ill. • Dallas, Texas • Los Angeles, Calif. • Miami, Fla. • St. Louis, Mo. • San Francisco, Calif. • Seattle, Wash. • Wichita, Kan. • Wichita, Mo. • Wichita, Neb. • Wichita, S.D.

Circle Number 321 on Reader Service Card

## AIR LIQUID Separator Pumps

In order to keep your system free of liquid and vapor impurities, these air-liquid separator pumps are designed to separate each through automatic pump, filter, and separator. The pump can be used in liquid and gas applications, as well as in liquid and gas applications. The separator can be used in liquid and gas applications, as well as in liquid and gas applications. The separator can be used in liquid and gas applications, as well as in liquid and gas applications.

**ROPER** ROCKFORD, ILLINOIS  
P.O. BOX 1000, ROCKFORD, ILL. 61101

Circle Number 322 on Reader Service Card



### Polaris Range is Increased Through the Use of Filament Wound Motor Cases

The Defense Products Division, Brunswick Corporation, was selected by The United States Navy as a participant in the design and fabrication of prototype second stage Polaris A-3 rocket motor cases. Brunswick's design and fabrication know how from previous programs was an important factor in being selected to produce this advanced high strength-low weight motor case.

son rocket motor case programs, including the Polaris, has resulted in an unmatched capability for rocket case design and fabrication. Brunswick offers a wide range of materials experience including the latest high strength reinforcements and resin systems.

From the fabrication of the insulator to the hydrazine of the completed motor case, Brunswick can supply complete "in house" capabilities. Original design concepts were

ported by computer analysis insure optimum motor case design for maximum strength/weight ratio. Serial automatic lubrication equipment and mechanically controlled resin content result in a uniform, reliable product.

Let Brunswick scientists and engineers analyze your requirements. Brunswick's demonstrated capabilities in filament winding assure the successful completion of each customer's contract.



**Brunswick**  
CORPORATION

Interested engineers will find it rewarding to discuss career futures with Braunstein, an equal opportunity employer. Write or call Brunswick Corporation, Defense Products Division, 1700 Meisler Street, Muskegon, Michigan.

## Wind Instruments: Almost

Amesbury Brass Works, Corp., Type Systems, Inc.  
turns designing & mfg. of: Cyl., Int.  
valves & strainers, etc.  
Watkins Investment Corp., 246 W. 42nd St., New York  
10018, N.Y.  
Whitcomb, Kenneth, Inc.  
Newport, R.I.

## Wind Socks &amp; Canes

Source: Fox & Wilton Co., Baltimore & adjacent Sta.  
 1900. 4th-10th St., E. 1st St. & B Street

Windshield, Windows,  
Electrically Heated

RESEARCH APPLICATION SERVICE DIV., THE IAC,  
10000 COUNTRY CLUB DRIVE, F. BOX  
10000, FARMERS, GA., 30204  
Telephone: 404/366-1000  
Telex: 404/366-1000  
Fax: 404/366-1000  
E-mail: [iaac@iaac.org](mailto:iaac@iaac.org)  
Web: <http://www.iaac.org>  
1. Report on the IAC, 10000 COUNTRY CLUB DRIVE, F. BOX 10000, FARMERS, GA., 30204  
Telephone: 404/366-1000  
Telex: 404/366-1000  
Fax: 404/366-1000  
E-mail: [iaac@iaac.org](mailto:iaac@iaac.org)  
Web: <http://www.iaac.org>

### Windshead Winners

Alan White Co., Memphis, Tenn.  
Young's Investment & Savings, Ltd.  
Mullins, Sullivan Co. 120, Arsenal Bldg.  
Nelson Power Co.

### Windows, Radiation Shielding

PAROLINE LIFTING CO., INC. 361 AVE. E. 45  
LANSING, MICHIGAN, U.S.A.

## W.

Advanced Technology Labs., Inc., American-German  
Army Award, 1st  
Alfred P. Sloan  
ALUMINUM CO. OF AMERICA. SEE ATW P. 98, 12  
American Express Co.  
American Express Co.

JAMES H. HARRIS, JR. & SONS, INC.  
 1000 N. W. 10th St., Miami, Fla. 33136  
 (305) 375-1100  
 JAMES H. HARRIS, JR. & SONS, INC.  
 1000 N. W. 10th St., Miami, Fla. 33136  
 (305) 375-1100

Jorden Deli Corp., Inc., 4750 Lawrence Ave.,  
 Sacramento 20, Calif.  
 Jorden Aircraft, Portland, Ore.  
 Jordon & Jordon Co.  
 Jorner, Anthony G., The AeroSpace Bldg.,  
 Sacramento 20, Calif.  
 Joseph, William, 200

John Wiley & Sons,  
111 River Street, New York, N.Y. 10038  
or J. John & Associates, Inc.,  
Huntington Beach, Calif.  
Nathan Sussman, Inc., 174 W. 14th Street, New York, N.Y.  
James H. Taylor, Inc., 100 W. 14th Street, New York, N.Y.  
James H. Taylor, Inc., 100 W. 14th Street, New York, N.Y.

[illegible][illegible]

Chester, Ore.  
 Joe Morris Sales Co., Inc.  
 Building 2000 East  
 Second Street & First, St.  
 Salem, Ore. of America, Inc. Western States Co.  
 Building 1000 West 1st, & 1st Street Co., Inc.

NOTRE DAME DE LA PAIX  
1000 W. 10th Ave., N. 1st Fl.  
Notre Dame, S.D. 58801-4000

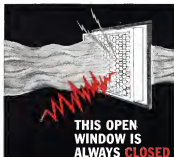
[illegible]

## Yokes, Cable &amp; Wire

Industrial Factors Engineering Ltd.  
 1911, Woodward Way, Littleport  
 Cambs CB6 3JF  
 General Agents Supply Co  
 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 9

Turn to page 261

for a revised,  
up-to-date listing of  
**DISTRIBUTORS**  
serving the aerospace  
industry.

[illegible]

**TECKNIT**  
Technical Wire  
Products, Inc.

154 DUNCAN STREET, CAMDEN, N. J.  
 7081 BRIDGE AVENUE  
 NEW YORK, N. Y.



## PRODUCT INDEX

[illegible]

## PRODUCT INDEX

[illegible]

[illegible]

ONLY ONE PUBLICATION COVERS THE ENTIRE AEROSPACE MARKET . . .  
**AVIATION WEEK & SPACE TECHNOLOGY**

Week after week, dramatic advances within the technological spectrum are reported in depth by the industry's largest editorial team of graduate engineers and aerospace specialists.

Through AVIATION WEEK, over 84,000 engineering-management men, responsible for aerospace industry progress, keep informed of current developments virtually as they happen. Because of this skillful coverage of timely industry events, readers and advertisers alike recognize AVIATION WEEK & SPACE TECHNOLOGY as the international technical authority in the aerospace field.

## Aviation Week & Space Technology

A McGraw-Hill Publication

**A POWERFUL EDITORIAL FORCE IS A POWERFUL SELLING FORCE**

# POXYGLAS

## A STORY OF FILAMENT WINDING CAPABILITY

The new production process developed by HILL shows assembly-line production rates and efficiency—while preserving laboratory precision control and accuracy.

The non-programmed hydraulic tensile embolism is the basis of the SC&B-developed filament weaving machines. Apparently stress is not fed back, and temperatures and humidity are tightly controlled. These stress are strongest in straight line weaving sequence for greatest efficiency and maximum chamber loading during take-off. Delivered cord and reinforcements, reduce quality and manufactur-



See of the numerous sportsball water cans manufactured by R348.

They have included the Third Stage Mustangs, the Second Stage Polaris A2, A3 and A8 Afters, the First Stage Polaris A3, the Second Stage Polaris A3 and the First Stage Skidoo.

The Glass Fiber Products Division of Black, Sealls and Nysson is located in a 65-acre site at the Avondale Industrial Park, 13 miles north and east of Phoenix, Arizona.

It has 130,000 square feet of securely controlled manufacturing area and additional space with unheated poultry facilities is available for contract processing.

The plant is totally adjusted by the following structural layout—and it is completely accessible by air, rail and automobile motor transport. An extensive amount of industrial value is also available.

## FROM WOODEN OIL TANKS TO THE SPACE AGE

Several years ago, the professors of Black Studies and History manufactured evidence of hate and racism.

In these rocky days, BGEA learned the value of developing new products for a new industry. Today much of the equipment now manufactured destined to the oil and gas industry was born cold and hot manufactured by BGEA.

This research and development will be the subject for the next manufacturing complex that is KILB today KILB has developed many products and applications in many industries.

ESAP is now a highly diversified company which has introduced new innovations in such fields as fuel control, nuclear-electronic measurement, test energy, over pressure protection, electronic pumps for submarines, steel structures for agriculture.



the necessities of weddings and stampings for suit-trim. And after extensive experience in textile manufacturing loan weavers, H&B has put entered the consumer field with a line of real and luxury dresses.

With its continuing program of research and development, STAM is looking forward to continue work on providing industry with better ways of producing a higher quality product at lower overall cost.

ES&B comes to the aerospace field with years of experience in broad industrial areas. And the experience gleaned from working with leaders in the oil, gas, chemical and power industries certainly can be put to excellent use in working at aerospace, one of the most critical industries.

If you have any manufacturing or processing problems—contact the giant from hole storage to the most sophisticated automation equipment—we can be of service to you.



BSB

BLACK, SIVALLS &amp; BRYSON

[Home](#) • [Search](#) • [About Us](#) • [Privacy](#) • [Contact Us](#) • [Feedback](#)

## TAMAR: A WORLD OF CAPABILITY



### AMERICAN GYRO / ECONOLITE / TAMAR ELECTRONICS / WIANCKO ENGINEERING

This grouping of seasoned organizations provides extended capability for research, design, development and production of military and commercial electronics. **Andrew gyro** provides high precision gyros, accelerometers, amplifiers, servo systems, components and instruments for all military applications. **Econolite** is a leader in dependable, economical traffic control systems and equipment. **Tamar Electronics** provides design, production and testing capabilities in high frequency, broad band antennas, RF airframe countermeasures systems, RF connectors, adapters and coaxial cable, and airborne and ground support electronics hardware. **Wiancko Engineering** is a specialist in measurement, providing all types of high precision transducers, and related data acquisition and rejection systems for missile and space vehicle testing. For further information regarding Tamar's world of capability write to Mr. John J. Wittkopf, Executive Vice President.

TAMAR ELECTRONICS



INDUSTRIES, INC.

201 North Main Street, Suite 100, Bldg. 200, Waco, TX 76787

1100 So. Los Angeles Blvd., Anaheim, CA 92705

## ANTENNA EQUIPMENT



### ANTENNAS

**Heliax**, a complete system of dielectric antennas for use in 100 to 120 GHz range with associated mounting, assembly, calibration, acceptance.

Write for Catalog #

**Transmitters**, a complete system of dielectric antennas for use in 100 to 120 GHz range with associated mounting, assembly, calibration, acceptance.

Write for Catalog #

**Waveguide**, a complete system of dielectric antennas for use in 100 to 120 GHz range with associated mounting, assembly, calibration, acceptance.

Write for Catalog #

**Heliax**, a complete system of dielectric antennas for use in 100 to 120 GHz range with associated mounting, assembly, calibration, acceptance.

Write for Catalog #



### HELIAX

#### FLEXIBLE AIR DIELECTRIC CABLE

**Heliax** is a flexible air dielectric cable for use in 100 to 120 GHz range with associated mounting, assembly, calibration, acceptance.

Write for Catalog #



### TRANSMISSION LINES AND WAVEGUIDES

**Transmitters**, a complete system of dielectric antennas for use in 100 to 120 GHz range with associated mounting, assembly, calibration, acceptance.

Write for Catalog #

**Waveguide**, a complete system of dielectric antennas for use in 100 to 120 GHz range with associated mounting, assembly, calibration, acceptance.

**Heliax**, a complete system of dielectric antennas for use in 100 to 120 GHz range with associated mounting, assembly, calibration, acceptance.

**Transmitters**, a complete system of dielectric antennas for use in 100 to 120 GHz range with associated mounting, assembly, calibration, acceptance.

**Waveguide**, a complete system of dielectric antennas for use in 100 to 120 GHz range with associated mounting, assembly, calibration, acceptance.

Write for Catalog #



### HUBLOC ANTENNAS

**Hubloc** is a complete system of dielectric antennas for use in 100 to 120 GHz range with associated mounting, assembly, calibration, acceptance.

Write for Catalog #

**CHICAGO:** 7 E. Box 607, Chicago, IL 60601  
**LOS ANGELES:** 1100 So. Los Angeles Blvd., Anaheim, CA 92705  
**NEW YORK:** 1100 So. Los Angeles Blvd., Anaheim, CA 92705

**Andrew**

**NEW YORK:** 1100 So. Los Angeles Blvd., Anaheim, CA 92705  
**WASHINGTON:** 1100 So. Los Angeles Blvd., Anaheim, CA 92705  
**PHILADELPHIA:** 1100 So. Los Angeles Blvd., Anaheim, CA 92705

ANTENNAS • ANTENNA EQUIPMENT • TRANSMISSION LINES



## Index of Products Advertised

*A special service designed to provide readers with quick guide to the product information contained in advertisements throughout this Buyers' Guide.*

[illegible][illegible]

**TRANSACTION®** Helps Keep Them Flying

Each U.S. Navy and Marine Corps aircraft is regularly updated and maintained in readiness by periodic induction into an Overhaul and Repair Department. Timely performance of the "O&R" mission presents fantastic scheduling and parts control problems.

In addition to installations at Norfolk Naval Air Station and at Alameda and San Diego on the West Coast, the Bureau of Naval Weapons is currently installing the TRANSECT Data Collection System in all Overhead and Branch Departments.

In these vital defense areas TRANSCATTER input stations — located throughout engine, air frame, instrument and avionics divisions — are continuously reporting overhaul progress and status in the interest of fast "turn around" and return to duty of the world's most effective manned Naval weapons.

Error-free data is recorded for accurate work load and labor distribution calculations and for quality control, stress withdrawals and material requirements. This indispensable data—continuously translated to punched tapes by Stromberg Computer—is immediately processed for control decisions by production supervisors and by top management. All directed toward maximum efficiency and the most productive use of the TACOMEX's DALLAS.

Write for informative brochure, "The Moving Link in Your Chain of Command."

**STROMBERG®**  
DIVISION  
GENERAL TIME CORPORATION  
THOMASTON, CONNECTICUT







[illegible]

**Scaphiopus** **Scaphiopus**

Agreement administered by: *Qualtrics Survey*, 100 North  
 Street, 4000, Irvine, CA 92618

0000-0000-0000-0000

**Glass & Mirror Co., 6 North Lake Place, Birmingham Ala. 35203-1714, Cor. No. 1980**  
Call most Windows Mobile Number about  
Monday, Aug. 1-4 PM EDT 1-800-333-3333.

## 595

**Florida**  
A. B. M. Jacobs, Inc., 2000 W. 21<sup>st</sup> St.,  
Miami, Fla. 33135, U.S.A.  
A. B. M. Jacobs, Inc., Building 1000, International  
Airport, Miami, Fla. 33126, U.S.A.

Accounting Service Co., Inc., 2044 N. W. 13th Pl.,  
Miami, Fla. 33125, U.S.A.  
Accounting Inc., International Airport, Miami, Fla.  
33126, U.S.A.

[illegible][illegible]

2000  
 2001  
 2002  
 2003  
 2004  
 2005  
 2006  
 2007  
 2008  
 2009  
 2010  
 2011  
 2012  
 2013  
 2014  
 2015  
 2016  
 2017  
 2018  
 2019  
 2020  
 2021  
 2022  
 2023  
 2024  
 2025  
 2026  
 2027  
 2028  
 2029  
 2030  
 2031  
 2032  
 2033  
 2034  
 2035  
 2036  
 2037  
 2038  
 2039  
 2040  
 2041  
 2042  
 2043  
 2044  
 2045  
 2046  
 2047  
 2048  
 2049  
 2050  
 2051  
 2052  
 2053  
 2054  
 2055  
 2056  
 2057  
 2058  
 2059  
 2060  
 2061  
 2062  
 2063  
 2064  
 2065  
 2066  
 2067  
 2068  
 2069  
 2070  
 2071  
 2072  
 2073  
 2074  
 2075  
 2076  
 2077  
 2078  
 2079  
 2080  
 2081  
 2082  
 2083  
 2084  
 2085  
 2086  
 2087  
 2088  
 2089  
 2090  
 2091  
 2092  
 2093  
 2094  
 2095  
 2096  
 2097  
 2098  
 2099  
 2100  
 2101  
 2102  
 2103  
 2104  
 2105  
 2106  
 2107  
 2108  
 2109  
 2110  
 2111  
 2112  
 2113  
 2114  
 2115  
 2116  
 2117  
 2118  
 2119  
 2120  
 2121  
 2122  
 2123  
 2124  
 2125  
 2126  
 2127  
 2128  
 2129  
 2130  
 2131  
 2132  
 2133  
 2134  
 2135  
 2136  
 2137  
 2138  
 2139  
 2140  
 2141  
 2142  
 2143  
 2144  
 2145  
 2146  
 2147  
 2148  
 2149  
 2150  
 2151  
 2152  
 2153  
 2154  
 2155  
 2156  
 2157  
 2158  
 2159  
 2160  
 2161  
 2162  
 2163  
 2164  
 2165  
 2166  
 2167  
 2168  
 2169  
 2170  
 2171  
 2172  
 2173  
 2174  
 2175  
 2176  
 2177  
 2178  
 2179  
 2180  
 2181  
 2182  
 2183  
 2184  
 2185  
 2186  
 2187  
 2188  
 2189  
 2190  
 2191  
 2192  
 2193  
 2194  
 2195  
 2196  
 2197  
 2198  
 2199  
 2200  
 2201  
 2202  
 2203  
 2204  
 2205  
 2206  
 2207  
 2208  
 2209  
 2210  
 2211  
 2212  
 2213  
 2214  
 2215  
 2216  
 2217  
 2218  
 2219  
 2220  
 2221  
 2222  
 2223  
 2224  
 2225  
 2226  
 2227  
 2228  
 2229  
 2230  
 2231  
 2232  
 2233  
 2234  
 2235  
 2236  
 2237  
 2238  
 2239  
 2240  
 2241  
 2242  
 2243  
 2244  
 2245  
 2246  
 2247  
 2248  
 2249  
 2250  
 2251  
 2252  
 2253  
 2254  
 2255  
 2256  
 2257  
 2258  
 2259  
 2260  
 2261  
 2262  
 2263  
 2264  
 2265  
 2266  
 2267  
 2268  
 2269  
 2270  
 2271  
 2272  
 2273  
 2274  
 2275  
 2276  
 2277  
 2278  
 2279  
 2280  
 2281  
 2282  
 2283  
 2284  
 2285  
 2286  
 2287  
 2288  
 2289  
 2290  
 2291  
 2292  
 2293  
 2294  
 2295  
 2296  
 2297  
 2298  
 2299  
 2300  
 2301  
 2302  
 2303  
 2304  
 2305  
 2306  
 2307  
 2308  
 2309  
 2310  
 2311  
 2312  
 2313  
 2314  
 2315  
 2316  
 2317  
 2318  
 2319  
 2320  
 2321  
 2322  
 2323  
 2324  
 2325  
 2326  
 2327  
 2328  
 2329  
 2330  
 2331  
 2332  
 2333  
 2334  
 2335  
 2336  
 2337  
 2338  
 2339  
 2340  
 2341  
 2342  
 2343  
 2344  
 2345  
 2346  
 2347  
 2348  
 2349  
 2350  
 2351  
 2352  
 2353  
 2354  
 2355  
 2356  
 2357  
 2358  
 2359  
 2360  
 2361  
 2362  
 2363  
 2364  
 2365  
 2366  
 2367  
 2368  
 2369  
 2370  
 2371  
 2372  
 2373  
 2374  
 2375  
 2376  
 2377  
 2378  
 2379  
 2380  
 2381  
 2382  
 2383  
 2384  
 2385  
 2386  
 2387  
 2388  
 2389  
 2390  
 2391  
 2392  
 2393  
 2394  
 2395  
 2396  
 2397  
 2398  
 2399  
 2400  
 2401  
 2402  
 2403  
 2404  
 2405  
 2406  
 2407  
 2408  
 2409  
 2410  
 2411  
 2412  
 2413  
 2414  
 2415  
 2416  
 2417  
 2418  
 2419  
 2420  
 2421  
 2422  
 2423  
 2424  
 2425  
 2426  
 2427  
 2428  
 2429  
 2430  
 2431  
 2432  
 2433  
 2434  
 2435  
 2436  
 2437  
 2438  
 2439  
 2440  
 2441  
 2442  
 2443  
 2444  
 2445  
 2446  
 2447  
 2448  
 2449  
 2450  
 2451  
 2452  
 2453  
 2454

[illegible][illegible][illegible]

Country	Year	Population (millions)	Urban population (millions)	Urban population (%)
Algeria	1980	10.0	4.0	40.0
Algeria	1985	11.0	4.5	40.9
Algeria	1990	12.0	5.0	41.7
Algeria	1995	13.0	5.5	42.3
Algeria	2000	14.0	6.0	42.9
Algeria	2005	15.0	6.5	43.3
Algeria	2010	16.0	7.0	43.8
Algeria	2015	17.0	7.5	44.1
Algeria	2020	18.0	8.0	44.4
Algeria	2025	19.0	8.5	44.7
Algeria	2030	20.0	9.0	45.0
Algeria	2035	21.0	9.5	45.2
Algeria	2040	22.0	10.0	45.5
Algeria	2045	23.0	10.5	45.7
Algeria	2050	24.0	11.0	45.8
Algeria	2055	25.0	11.5	46.0
Algeria	2060	26.0	12.0	46.2
Algeria	2065	27.0	12.5	46.3
Algeria	2070	28.0	13.0	46.4
Algeria	2075	29.0	13.5	46.5
Algeria	2080	30.0	14.0	46.7
Algeria	2085	31.0	14.5	46.8
Algeria	2090	32.0	15.0	46.9
Algeria	2095	33.0	15.5	46.9
Algeria	2100	34.0	16.0	47.1

[illegible][illegible]

**South Division**  
Atlantic Edge Co. 1996, Belmont, Pa. Char-  
ter, 9 x 12, 1.00 (1st) No. 4900  
Barnes and Noble, Jamaica, N.Y. 1996, 1.00, No. 4900

[illegible][illegible][illegible]

Corbin's American Express, 1000 Broadway, New York, N.Y. 10038  
Corbin's American Express, 1000 Broadway, New York, N.Y. 10038  
Corbin's American Express, 1000 Broadway, New York, N.Y. 10038  
Corbin's American Express, 1000 Broadway, New York, N.Y. 10038

**Control Region**  
 Address: Adhikarika, Tenzin Gyepo - 4221 Thend  
 Address: Karmu City 12 - 4221 Thend  
 11/20/2011  
 Address: Karmu City 12 - 4221 Thend

Amalgamated, Portland, ME 04101; 2 1-205, CHS  
Box 1339  
Box Abington, Maine 04930; Edgar Ave., Old Town  
Maine, ME 04468, 1-205, CHS Box 1339  
Anderson Pressing Co., Inc., 14400 County Road  
50 Portland, ME 04101, 2 1-205, 1-400 CHS Box  
1339  
Apparelco, Portland, Inc., 1024 South Main St.,

## Guaranteed Protection with Performance Tested

## ENVIRONMENTAL MODULES

ALL CONDITIONS \* WATER COLLIER  
AC 60 or 680 miles DC 20V

GOALS + WANTS  
FILTERS  
CONUNDRUMS

### Electronic Checkout Equipment

#### Personnel or Equipment Vans

Computers

## Ground Support Air Conditioning

Protect your electronic equipment from overhead—prevent loss spots. Improve reliability and life of components with Environmental Modulator. In the past 30 years Helicore has designed and built more specialized military air conditioning equipment for a wider variety of applications than any other company. This experience is immediately available to solve one of your tomorrow's control problems.

Consult Vase IFF/IFP Marubeni Canada File



SPECIALIZED AIR CONDITIONING  
C. D. HOANSON COMPANY, INC.

1945-1946 Season • Ice Accum. 25. Cold • Windy 3 1/2 hrs

There is a Woodward Fuel Control for every gas turbine engine application. Our ninety years of experience in the governing field is available throughout the world. Write for complete information on all Woodward Fuel Controls.



WOODWARD GOVERNOR COMPANY • ROCKFORD, ILLINOIS

Age Culture, Colorado • Schepel, The Mariner

\* 本表数据来源于《中国统计年鉴》、《中国人口和就业统计年鉴》、《中国农村劳动力资源调查数据库》。

[illegible]

1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656,

[illegible][illegible][illegible][illegible]

1. *Staphylococcus aureus*  
 2. *Staphylococcus aureus*  
 3. *Staphylococcus aureus*  
 4. *Staphylococcus aureus*  
 5. *Staphylococcus aureus*  
 6. *Staphylococcus aureus*  
 7. *Staphylococcus aureus*  
 8. *Staphylococcus aureus*  
 9. *Staphylococcus aureus*  
 10. *Staphylococcus aureus*

[illegible][illegible][illegible]

From Light Twin to     
to     
FOUR-ENGINE  
TRANSPORT..  
you can  
depend on a  
**CAIR RADOME** 

Whatever the size and make of your aircraft... whatever your radar system... you can enjoy the maximum transmission efficiency, high strength-to-weight ratio and long service life of a non-aerated CAIR Radome.

Two basic types of CAIR Redones are available. "Exact-Replacement" Redones are complete interchangeable with redones installed per original aircraft service bulletins. "Custom" Redones, key designed by Chamberlain, have many features which facilitate radar installation and provide fast, easy, unrestricted access to radar components for service inspection and maintenance.

Manufactured by skilled technicians in Chamberlain's modern, completely equipped shops, all CAIR Redomes are warranted both as to workmanship and materials.

CAR, INC. increased Business and Business Availability  
are to use as thought, clearly, clearly, and combined  
developmental services and as well as combined, clear, clear,  
multiple, multiple, clear, and clear, multiple, multiple,  
clear, clear, and clear, for complete details on the CAR  
Business and Business Availability.

**CHAMBERLAIN AVIATION, INC.**  
P.O. BOX 6112 • Joliet 12, CHIL  
Phone: 815-725-1115 • Telex: 246 329 0330

**LOOK  
TO  
HOBART**  
...WHEN  
PRECISE  
POWER FOR  
VITAL LOADS  
IS A MUST!



**TYPICAL USE:**  
To best utilize cells for life under the sun's intensity is outer space. Also for brilliant light generation for showrooms and military applications.

Here's a check list of special uses for engine controllers—

- Maintaining power for periods of time when sustaining power fails completely
- For use voltage in the late or no other settings for process control
- Frequency converters—60 or 50 cps to 50 or 60 cps; 50 or 60 cps to 450 cps
- Converters—60 or 50 cycles a.c. to d.c. converters ranging from 5 to 250 volts for a wide variety of regenerative and dc arc-starting operations; battery charging electrolytic processes; arc lamps and other loads

## simulation applications

- Engine-generator sets in villages to 480 and in frequency of 30, 60 and 400 cycles
- Over fifty years experience in manufacturing electrical equipment qualify Halbert to offer you the guarantee of satisfaction in any service they may perform for you. Without reservation Halbert Motor Generators are fully guaranteed to meet a high quality standard incorporating the latest in design, materials and construction.

Robert Gray, Inc., 101 W. 42nd St., New York, N.Y. 10018  
 Tel. (212) 512-1000  
 Fax (212) 512-1001

[illegible]

Airco Waste Control, Inc., Airco, Englewood  
Clarks, Memphis, TN, South of Gas Lines, and

Author's Address: Department of Psychology, University of Illinois at Chicago, Chicago, IL 60607.  
E-mail: [john@uic.edu](mailto:john@uic.edu)

1970. *Journal of the American Statistical Association*, 65: 1173-1178.

© 1999 Blackwell Science Ltd, *Journal of Internal Medicine* 245: 371–379

Federal Aviation Agency, Aviation Administration,  
1201 West Washington Avenue, Room 2000, St. Paul, MN

Rev. Alexander Dyer, Box 28, P. O. Box Field, Texas,  
Ariz. 5-1, 1951.

Journal of the American Statistical Association, 1991, Vol. 86, No. 414  
 14 Aug 91, 1:40 PM, p. 544  
 Source: William J. Hall, editor, The American Statistical Association, 1991, p. 544.

San Francisco, California, 1911-12. 14 pages. 4. Phary

Texaco, Inc., P. O. Box 1440  
 Houston, Texas 77251, P. O. Box 1440, Texas  
 City, Tex. 75610, P. O. Box 1440, Tex. 75610

Manuscript received Dec. 7, 84; 1st revision received  
Jan. 11, 1985; 2nd revision received May 1985

If you have a specific power conversion problem why not let Wabco help you? Write to the address below for literature and question: all without obligation!



**MOTOR GENERATOR CORPORATION**  
MORGAN STUDIOS OFFICES  
Box 44-122, Troy, Ohio, U.S.A. Cable: MOGEN







For American Trade Article:  
 Mr. J. J. Murphy, Chief, Acquisition-Operations,  
 P. O. Box 14-0000, Room 474, The  
 Pentagon, Arlington,  
 Mr. W. M. Smith, President of Agents, South Atlantic  
 Regional, 10000 S. 1st St.,  
 New Orleans 16, La.  
 Mr. James J. Jones, Jr., 4001 - Goodwin  
 Box 2-10, Box 100, Andrews, Alaska  
 Alaska Airlines, Inc.  
 Mr. R. H. Thomas, Bureau of Aeronautics, Box 40  
 (Mailstop 1), 2000 Randolph, Dayton, OH 45433  
 Southern Airways, Inc.  
 Mr. Ross L. Jones, Executive-Flightline & Ground  
 Support, 10000 S. 1st St.,  
 New Orleans 16, La.  
 Mr. R. L. Jones, Director, Passenger Planning & Ticket  
 Control, Southern Airways, Inc., 10000 S. 1st St.,  
 New Orleans 16, La.  
 Mr. J. J. Murphy, Chief, Acquisition-Operations,  
 P. O. Box 14-0000, Room 474, The  
 Pentagon, Arlington, Va.  
 Mr. J. J. Murphy, Chief, Acquisition-Operations,  
 P. O. Box 14-0000, Room 474, The  
 Pentagon, Arlington, Va.

Mr. W. C. Lathrop, President, Agents, International  
 Sales, 10000 S. 1st St.,  
 New Orleans 16, La.  
 Mr. W. C. Lathrop, President, Agents, International  
 Sales, 10000 S. 1st St.,  
 New Orleans 16, La.  
 Mr. W. C. Lathrop, President, Agents, International  
 Sales, 10000 S. 1st St.,  
 New Orleans 16, La.  
 Mr. W. C. Lathrop, President, Agents, International  
 Sales, 10000 S. 1st St.,  
 New Orleans 16, La.  
 Mr. W. C. Lathrop, President, Agents, International  
 Sales, 10000 S. 1st St.,  
 New Orleans 16, La.  
 Mr. W. C. Lathrop, President, Agents, International  
 Sales, 10000 S. 1st St.,  
 New Orleans 16, La.

## SPECTROLAB

auxiliary solar power  
 systems, solar simulators,  
 acquisition and guidance  
 systems, multilayer filters,  
 thin-film research, optics  
 and electro-optical  
 instrumentation.



SPECTROLAB—leader in the field of solar power systems technology; has provided more high-reliability solar cell panels for spacecraft and satellites than all other firms combined. More than 2000 square feet of active solar cell arrays in use! ■ Solar power systems, solar simulators, optical tracking systems, thin-film research, acquisition and guidance systems, multilayer filters, thin-film research, optics and electro-optical instrumentation. Write today for product literature.

**spectrolab**

Division of Zenith Electronics, Inc.  
 13822 Sherman Way, North Hollywood, California  
 Tel. 818-705-1500 • 705-1540 • TWX N 100-7547

For more

information

about products

and services

advertised in

the

1963 BUYER'S

GUIDE ISSUE

fill-out the handy

READER SERVICE

CARDS

on pages

257-260

# SMITH/PRECISION NEEDLE BEARINGS

## AIRCRAFT NEEDLE ROLLER BEARINGS

Track Roller Bearings — NAS 522 and NAS 535 Series  
 Self Aligning Needle Bearings — NAS 524 Series  
 Airframe Needle Bearings — NAS 525 Series

## SMITH/PLAIN SPHERICAL BEARINGS

Are precision, spherical ground for perfect fit  
 With steel centers and, two-piece outer ring with  
 minimum positive clearance during installation and  
 when under load.  
 Fully hardened ring and ball.  
 Controlled clearance, ring to ball.  
 Full bearing area.

## INDUSTRIAL CAM FOLLOWERS and YODE TYPE NEEDLE ROLLER BEARINGS — From Stock

HIGH TEMPERATURE and SPECIAL PURPOSE NEEDLE ROLLER BEARINGS — Can be engineered and developed to solve your problem.

## PRECISION HARDENED and GROUND AIRCRAFT PARTS

Production automatic screw machines, heat treat and grinding facilities. Send your photo for quotation.

## SMITH BEARING DIVISION

Accurate Bearing Company  
 440 North Avenue, Garwood, New Jersey

Circle Number 262 on Reader Service Card

BOWSER-BRIGGS OFFERS YOU, FREE, A 28 PAGE FIELD MANUAL . . . covering aviation fueling, tank trucks, tank farms. Packed full with plans, specifications and actual photographs.

Get your copy of this practical and useful book—full (recently updated) field manual. It will indicate many ways to cut time and save on costs. If you are making plans for any new refueling operation, by all means write for your copy now.

Test various pump refueling, installation, tanks, tanks, pumps and how to make some refueling savings on flying. . . Fully illustrated and written for engineers for operating personnel.



BOWSER ENGINE EQUIPMENT DIVISION  
 CHICAGO, ILLINOIS

## FILTER SEPARATORS

FOR AIRCRAFT FUELING  
 AND TANK FARM

MAIL FOR COPIES  
 BY RETURN

Bowser, Inc.  
 Research-Design Filterable Division  
 Dept. 447, Oakdale, Tennessee

YES! Send this manual at no cost or obligation to me

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

Circle Number 262 on Reader Service Card

Turn to page

267 for a

consolidated

listing

of

FAA

CERTIFICATED

REPAIR

STATIONS

coded to

show type

of work

performed.

# A Complete Line of Fasteners

## For Metal Castings, Machined Parts and Assemblies

### Self-Coil Standard Thread Insert

Welds easily into tapped holes, forms itself in the metal filling threads with expanding pressure. Won't loosen. Drills no extra holes, flanges, or seal destruction.

### Self-Coil Screw-Lock Insert

Locks screws into tapped holes. Holds tight against impact and vibration with lock washers.

### Stripes Tap-Lock Nut

Efficient nut for lock washers and other external locking devices. Not open until the bolt is in the lock.

### Stripes Conical Nut

Double threaded with locking flange in center. Conical tapered lower end and quickly removed if it forces on bolt.

## For Sheet Metal

### Stripes Countersunk Weld Nut

Throat can't be loaded by pulling nut. Welds into sheet metal. Won't pull out. Won't pull out.

### Stripes Flat Weld Nut

Counter flanging collar for quick easy installation. These weld nuts are for any electrical connection.

### Stripes Clinch Nut

Two halves. One half fits into hole, the other half fits into hole. One half is welded into hole, the other half is removed. One half is removed. One half is removed.

### Tek Weld Nut

Welded in protective mold type. Also available in other types. One half of the type with locking feature.

## For Plastics

### Standard Stripes Inserts

Placed by hand or machine into molten or drilled holes. Will retain tapping after removal from hole. Provides torque and pull strength greater than steel wires.

### Stripes Clinch Insert

All features of Standard Stripes Insert, plus an extra for strong and fully insulating electrical contact.

### Stripes Flange Insert

Some features of Standard Stripes Insert, plus flange to hold down conductive contact, springs a flat electrical and mechanical contact.

### Stripes Flange Insert

Some features of Standard Stripes Insert, plus flange to hold down conductive contact, springs a flat electrical and mechanical contact.

### Stripes Conical Insert

Especially adaptable to needs of design engineers. Welds into molten plastic or machine-drilled holes. Will retain tapping after removal from hole. Provides torque and pull strength greater than steel wires.

### Self-Coil Fish Insert

For strong, low cost threads in plastic. No need for a separate hole. Will retain tapping after removal from hole. Provides torque and pull strength greater than steel wires.

### Stripes Wedge Insert

For threads of maximum strength. Will retain tapping after removal from hole. Provides torque and pull strength greater than steel wires.

## For Woods and Particle Board

### Self-Coil Double Thread Insert

Self-tapping. Provides double thread strength. Will retain tapping after removal from hole. Provides torque and pull strength greater than steel wires.

### Self-Coil Wedge Insert

Self-tapping. Increases thread strength. Will retain tapping after removal from hole. Provides torque and pull strength greater than steel wires.

### Stripes Fish Lock Nut

Stronger than straight threaded nuts. Will retain tapping after removal from hole. Provides torque and pull strength greater than steel wires.

### Stripes Wedge Insert

Self-tapping. Increases thread strength. Will retain tapping after removal from hole. Provides torque and pull strength greater than steel wires.

All of these fasteners are stock items available for immediate delivery in a wide range of sizes. Self-Coil's experienced engineering staff will be glad to assist you in solving your fastening problems at the design level. Write today for detailed literature.



**HELI-COIL CORPORATION**  
3012 Shelburne Road, Danbury, Conn.

In Canada: ARMSTRONG MECHANICAL ENGINEERING LTD.  
8015 Avenue Macdonald, Montreal 15, Que.

**PHILIPS MANUFACTURING DIVISION**  
Helix-Coil Corporation, Danbury, Connecticut

**GRIP-NUT COMPANY**  
Subsidiary of Helix-Coil Corporation  
Rogers Ave., South Woburn, Indiana

400

From ITT Surprenant

## Latest Developments in Electronic Wire & Cable

ITT Surprenant—recognized for over 25 years for originating new electronic wire and cable specifications—now has these latest developments. Send coupon for details.

**ITT Surprenant**

## SEND COUPON TODAY

ITT Surprenant Manufacturing Co.  
1120 Basking Street  
Clinton, Massachusetts  
Please send me details on the products checked below:  
REFLECTION ( ) HAVE IN MIND ( )

- ☐ "SERVO" coated stainless steel ribbon wire and cable
- ☐ Shieldable wire with extreme resistant high temperature wire and cable
- ☐ High and low reflecting wiring systems
- ☐ Alloy 60% wire and cable—the most important development in low resistance alloy materials 20% conductivity and the strength of annealed copper has been (2) times the flex life, very high tensile and tensile strength. Fast proof—unimpaired.
- ☐ Stable assemblies for ground up 200 mils and universal cables
- ☐ Special miniature-size connectors for cable assemblies

ITT Surprenant Mfg. Co. (Mailing)  
1120 Basking Street

Name \_\_\_\_\_  
Company \_\_\_\_\_  
Position \_\_\_\_\_  
Street \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

Circle Number 281 on Reader Service Card

203



# Powertron

## A C POWER SUPPLIES

A complete line of single phase, two phase and three phase electronic power supplies with 60-600 power ratings from 1 watt to 1 KW.

Features:

- Precision 40, 6.65 output better than 1% (no-load) (no-load) (no-load)
- No regulated output voltage
- Low distortion
- Many standard defined features to suit your requirements.

Write for data and literature: POWERTRON, 10000 GARDEN CITY ROAD, GARDEN CITY, N.Y. 11530

**INDUSTRIAL TEST EQUIPMENT CO.**  
35 EAST 11th STREET • NEW YORK 3, N.Y.

Circle Number 281 on Reader Service Card

Turn to page 241

for  
an alphabetical listing  
of

**MANUFACTURERS' NAMES & ADDRESSES**

Circle Number 281 on Reader Service Card

204

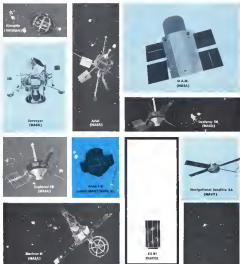
Circle Number 281 on Reader Service Card











Heliotek, although a new organization, has supplied the solar cells for fourteen space vehicles, including those illustrated above. These solar cells were supplied to the National Aeronautics and Space Administration, the Canadian Defense Research Board, and the U. S. Navy, by Heliotek. Heliotek's advanced technical capabilities, resulting in superior solar cell performance, product uniformity, quality and reliability, and a record of rapid on time deliveries were the basis for its selection as the supplier. Heliotek was the first U. S. manufacturer to make available and deliver to satellite users large quantities of the new radiation resistant P<sup>+</sup> on P<sup>-</sup> silicon solar cells. To obtain the benefits of superior products and proven performance for your space project, contact Heliotek for information and technical assistance.

**SOLAR  
CELLS BY**



Division of Technicon Electronics, Inc.  
12500 Glendora Ave., Sylmar, California

Circle Number 18 on Reader Service Card

# TAPER-LOK

THE new concept  
FASTENING SYSTEM

TAPER-LOK, designed and developed by Briles Engineering, is PROVEN. Briles Engineering has produced over 10,000,000 TAPER-LOK fasteners for use in a wide variety of fastening applications in today's aircraft, including the Douglas B-52H Superfortress, the C-141 Star Lifter, the Douglas Hot Cycle Rocket System and the Lockheed C-141 Star Lifter. Making "WASHERMUT" was capable of major aircraft requirements of MIL-N-25227.



Degree of peripheral and radial compression stresses, induced by the controlled interference fit, to greatly enhance fatigue life.

## EFFECT OF TAPER-LOK'S INTERFERENCE FIT ON FATIGUE LIFE

Interference	Life (12,000 psi)
0.001	10,000 cycles
0.002	25,000 cycles
0.003	200,000 cycles
0.004	700,000 cycles
0.005	900,000 cycles

**DESIGNED AND DEVELOPED BY**  
**BRILES MANUFACTURING**  
1415 EAST GRAND AVENUE • EL SEGUNDO, CALIFORNIA

Circle Number 20 on Reader Service Card

